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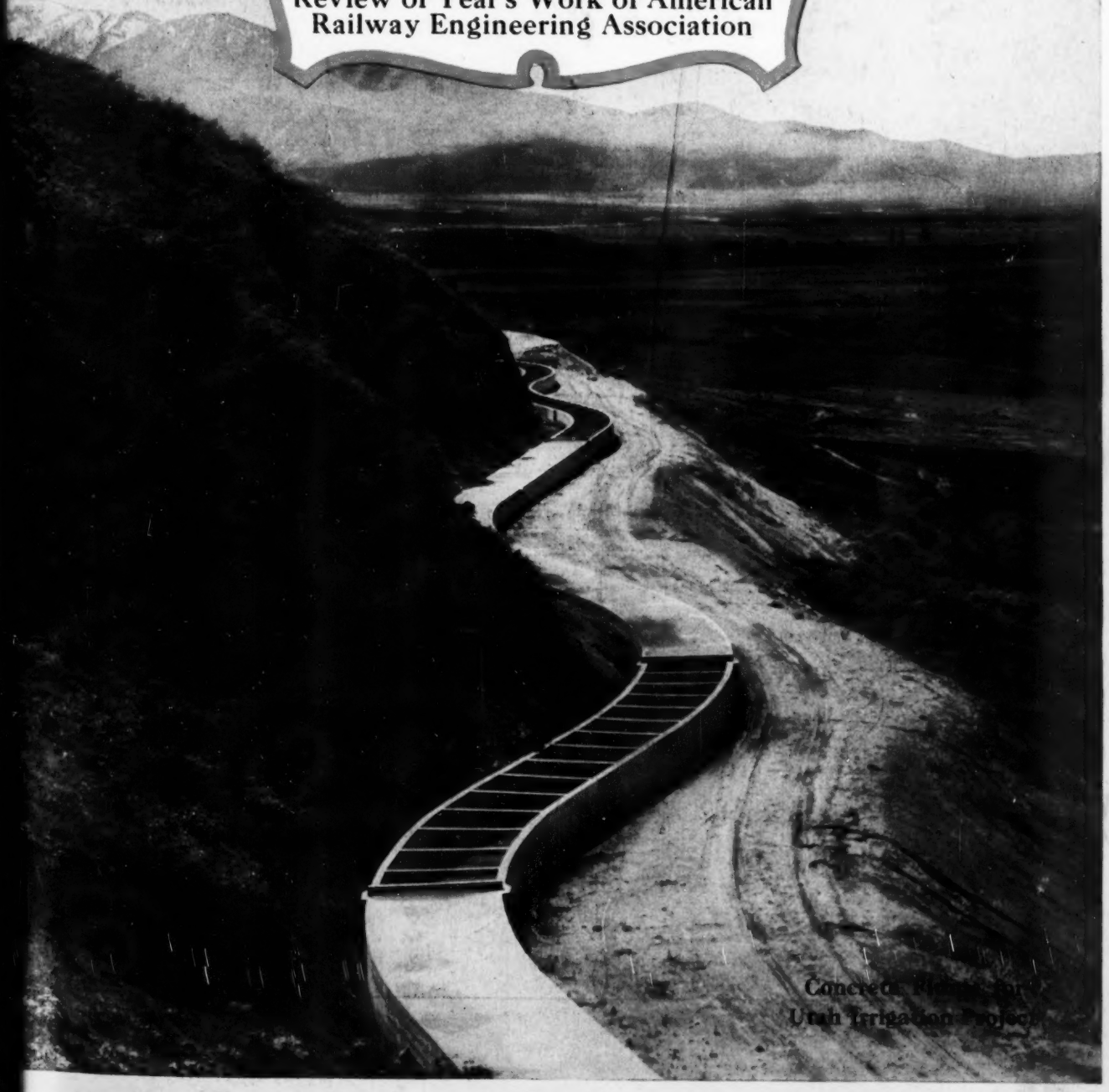
In this issue

New York City Garbage-Reduction Plant
By H. V. SCHIEFER

Multiple Air-Chamber Tunnel Shield
By JOHN F. O'ROURKE

Review of Year's Work of American Railway Engineering Association

March 21 1918



Concrete Flume for Utah Irrigation Project

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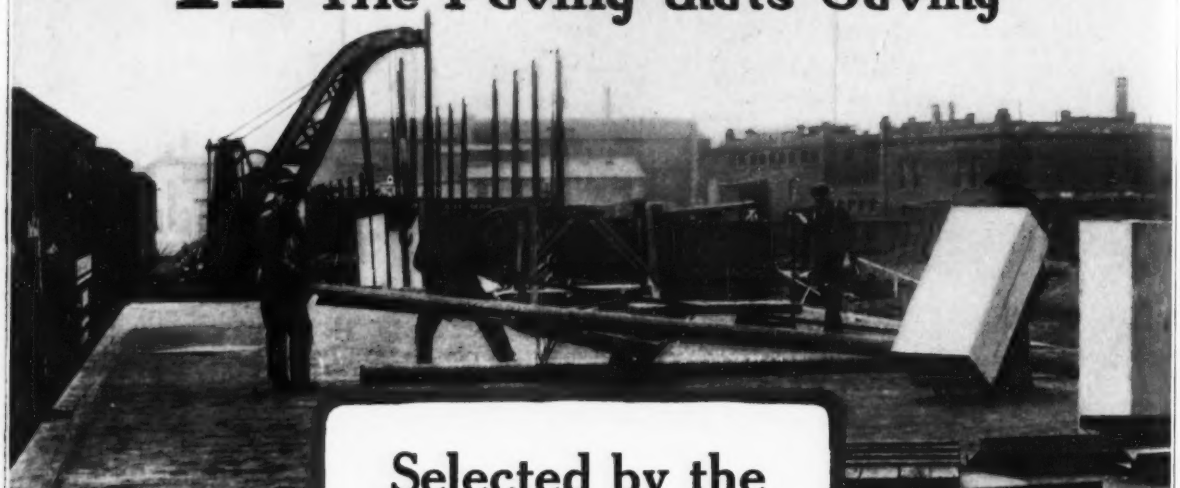

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This photo shows Kreolite Lug Wood Blocks on a loading platform of the Pennsylvania R.R. at their Erie, Pa., Warehouse. Lug Blocks were selected for this work for two reasons. First, because all danger of "buckling" is eliminated—when the blocks absorb moisture and expand the LUGS compress and take up the pressure. Second, these blocks are exceedingly durable and easy to truck over. Full data on request.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, Consulting Editor

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Concrete Ship Passes First Trial

THE first real sea-going concrete ship has been launched successfully. Today it floats on even keel and with uncracked hull in the element for which it was designed. Thus has been passed the first, and possibly the greatest, test to which it will be subjected, though its unqualified success is not even yet assured. Not until it has "found itself" in the crack and wrench of the high seas in storm will the concrete construction cease to be experimental and take its place in ship designs even in the present days of crying need. Meanwhile the Government is going ahead with all proper speed on its own concrete ship program. More haste, which is being urged just now in some quarters before adequate knowledge of detail is at hand, will surely mean less speed in the critical days of next fall and winter, when ships will count most.

Democracy in Society Management

IN THE amendment of the constitution of the American Society of Civil Engineers, that which is most needed is one which would restrict to each district the privilege of voting for the directors from that district. This is a democratic proposal that would receive almost unanimous approval. The absurdity of members all over the country having a voice in determining who shall represent, let us say, the thirteenth district, embracing Nevada and northern California, is apparent to all. With that amendment, of course, would have to go an equally democratic method of selecting the regular nominees for directors. These are minimum requirements. Once they are operative—or possibly long before that if we have an intelligent and aggressive critical wing—there will be further amendments tending to put greater life and more power into the local, and ultimately the district, organizations. The signs of the times point in that direction.

"His Majesty's Opposition"

THE proposed revision of the constitution of the American Society of Civil Engineers has been defeated. Out of a membership as of Jan. 1 of 8590, only 24 per cent., or 2101, voted. Of the votes cast 1556 were opposed to the revision and 546 favored it. The rejection may be due in part to resentment that a personal issue was injected into the discussion. If the total vote of each district were known one might form some judgment on that score. Certain it is, though, that a number of the revised sections did not have any great degree of backing, notably the one which would have made construction experience necessary for all membership. Now that the revision is dead, it is necessary to take in hand at once piecemeal revision. Unfortunately for the society there is no clearly recognized leadership except that of the management—which results in peace, but also stagnation. Intelligent agitation would stimulate new society activity and force to the front those issues which require new constitutional authority or forms. In the British Parliament the value of the minority party's critical function is so clearly recognized that the opposition is dignified with the title of "His Majesty's Opposition." Who shall lead—not an opposition—but a critical wing of the American Society of Civil Engineers? Whose sense of duty to the organization will encourage them to accept the odium that comes with the holding and pressing of views opposed to those of a traditionally conservative management? They can do a great work for the society. They will not lack for followers.

New York Points the Way in Garbage Utilization

THE utilization of a billion pounds of waste foodstuffs in a year is made possible by the New York City garbage-reduction plant described on p. 555 of this issue. Both grease and fertilizer are recovered. Each is needed now as never before. Most American cities pay to get rid of their garbage. New York City will receive a million dollars in five years from hers, delivered on scows at the waterfront. The contractor expects to make a good profit from the refuse after paying the cost of water transportation, reduction expenses and capital charges on a large and complicated mechanical plant. At the same time he will be adding to the fat and fertilizer supply and, by means of the latter, to the food supply of the country. Every city which is paying out instead of taking in money for garbage disposal should lose no time in having a careful engineering investigation made to determine whether and how soon it also can turn garbage outgo to income. If local conditions do not favor reduction, or if so much capital as reduction demands cannot be had until after the war, then attention should be turned to utilization by feeding to hogs—as is being practiced in an increasing number of cities. This is no time to waste garbage, much less to drain down the fuel supply of the country to burn it. Every few weeks brings news of the closing down of a city garbage incinerator and the diversion of the garbage to hogs. Feeding or reduction should be the rule, at least while the war lasts.

Bandar-Log or Bee?

FROM the time a monkey opens his eyes in the morning until drowsiness overpowers him at night, he is pretty much a law unto himself. He does anything he wants to, when he wants to, and as long as he wants to. A whimsical individualism sums up his philosophy of life. The day's end finds him just where he was in the morning. The tribe—bandar-log, Kipling calls them—respond to any leader of the moment and as quickly quit him to follow another or to fetch up individually with a brand-new, suddenly-caught and all-absorbing idea.

Like any other philosophy, it is a charming one if you like the net results of it. The monkey does. On the contrary, the bee doesn't. The bee insists on organization by functions. His philosophy is self-sacrificing, vigorous and stern—a Spartan philosophy applied to production. "Beeficiency" is the Taylor System raised to the *n*th power; and the bee doesn't get the honey.

If the bee had sense, he'd maintain his present organization a few hours a day—which would easily supply his wants—and be a bit bander-logish the balance of the time. But he cannot. The reason is because he doesn't think. He's a machine that is a part of a bigger machine. On the other hand, if he did think, he'd immediately tend to become individualistic, and the moment that happened the organization would begin to wabble. There would be argument about how the comb should be built, who should build it, who should boss it, how much honey should go to each; societies for the prevention of this and that would be formed. Social workers must eat; so must bosses; so must societies for the prevention of things.

Nature did not see fit to devise a species having the merits of bandar-log and bee,—a sort of bandar-bee.

A bandar-bee would help us a lot just now. It would be the real super-thing. It would be highly cooperative for a few working hours and highly individualistic the rest of the day. It would accept the notion that working together bee-fashion is the answer to the question of maximum production in minimum time; but being a super-thing, it would reject the notion that the honey gathered should all get into the hands of a few crafty speculators to be sold back at the speculators' price. It would control distribution with the same bee-like cooperative efficiency that it used in production.

It would accept the axiom that self-expression is necessary to a thinking super-thing—that monkey play in a monkey way is after all the best fun in life. It would approve the bandar-log system, in which the individual in his idle hours may sit on a limb and philosophize, or try a new way of weaving twigs, or join the bunch in a frolic, or play with the kids.

Obviously the bandar-bee would be a clear and direct thinker. He would be an intense individualist—so intense an individualist that in order to have the maximum number of hours a day for individualism, he would sink his individualism when he came to his production and distribution hours, and be an intense coöperator. He would treat as wasters those super-bees who would work themselves and others without any thought of the monkey play merely to amass a personal pile of honey. There would be piles of honey, adequate personal piles, but not huge ones.

Individualism and self-interest are about the same thing. The date when the bandar-bee will appear on the earth depends upon the amount of hammering which mankind must undergo to pound into it a realization of the fact that in the long run self-interest can be most permanently promoted by intense and unselfish cooperation in production and distribution.

Concrete Office Building
An Example for the Future

IF THE new army and navy building described in the news pages of this journal last week is turned over to the Government for occupancy on Aug. 15 as planned, it will be a triumph for reinforced concrete. At Washington today the primary requirement for any building is speed. In the case of offices in the sections much visited a second requirement is appearance, and there must also be economy in cost. In all three of these requisites the new concrete buildings as designed equal or surpass their few competitors, which is most surprising when one considers how short a time ago concrete buildings were considered slow to erect, besides being costly and uninviting in appearance. When such a building can successfully compete with temporary construction for war-time needs, its fire-resistive qualities make it a far superior type. The designers and builders have an unparalleled opportunity to produce an example of the greatest value for future factory owners.

The First Replacement
Regiment of Engineers

THE engineer troops of the United States have a high reputation for efficiency to maintain, and the construction men of the country cannot afford to let themselves be represented in the European war by anything short of the best personnel that can be secured. It is true that contractors, civil engineers and trained

technical men have volunteered in such numbers that existing and prospective engineer organizations have an ample supply of commissioned officers; but the same thing cannot be said of the enlisted men and non-commissioned officers. This is not for lack of patriotism, but because most of the desirable riggers, machinists, blacksmiths, foremen, hoist operators, carpenters and other skilled workmen are either already employed on Government work of immediate importance, or are registered in the draft. Because of the great volume of necessary Government work to be done this year, it is all the more important that the workmen not needed on it, especially those who are drafted, should make sure that they, individually, are employed in engineer organizations at work in which they are skilled. Unless each man himself sees to this point, a large number of men who are needed as engineers will be lost in other branches of the service. This has proved to be the case with the first draft army, in spite of all the precautions of the War Department. The readers of this journal should see to it, therefore, that they, their employees or friends who are drafted or who can be spared from ordinary work, volunteer in the engineers. The surest way of doing this, and the one which assures earliest service abroad, is to join the replacement regiment at Washington Barracks, which can be readily done, as is brought out in the news pages of this issue.

Hudson River Highway Crossing Is a National Problem

ACTION taken by the states of New Jersey and New York looking toward the construction of a highway tunnel under the Hudson River between New York and Jersey City is a matter that concerns the entire country. The National Government, therefore, should join in the planning and execution of the work.

A road connection across the river is of country-wide significance as part of the terminal machinery of the port of New York. It is hardly less important as a highway link between groups of great military establishments in districts of concentrated highway freight traffic now separated by a wide and unbridged harbor.

Along a 150-mile front the Hudson is a barrier to road traffic. Until recently the local as well as the national authorities were indifferent to the problem contained in this situation. But the local communities have been roused from their apathy by the experiences of our first war winter. They have reached the conviction that the river barrier must be removed. The official action of New Jersey and New York represents a real public awakening.

The national authorities have equal cause for recognizing the urgency of the problem. That continuity of highway routes is vital to effective transport service forced itself upon the Government's attention rather pointedly last September, when quick work became necessary to link up a few hard-road through routes in the Eastern States in order to move the army motor-truck trains. That lesson has very direct application to the case of the road gap at the Hudson. In fact, last winter's experiences gave clear proof that New York's insularity is not merely a source of weakness to the metropolitan community but a danger to the whole country.

To what extent shiping delays caused by the terminal congestion of last fall and by the later bunkering difficulties were made worse by the lack of adequate means of road transport across the river has not been studied in detail, but the nature of the effect is patent. No great stretch of imagination is needed to see a connection between the terminal troubles at the port of New York and the ever-to-be remembered workless and heatless days for which Fuel Administrator Garfield assumed responsibility.

The New York terminal question is intricate and of great magnitude. It is primarily a railway matter, but road traffic is intimately related to it. Some factors of the problem stand out in very obvious manner. The pier and shipping space taken up by the many thousands of vehicles ferried across the river every day, the hampering of freight movement by team delays and lighterage congestion, and the needless burden on the lighterage system arising from the shortcomings of team delivery, are among the elements whose joint effect is to diminish terminal capacity and expedition. Road facilities have a bearing on each one of these elements of difficulty. That a highway route across the Hudson, by way of either a bridge or a tunnel, will affect this terminal situation profoundly is beyond all doubt.

New Jersey has already appointed a commission to proceed toward the construction of a tunnel as soon as New York is ready to coöperate, and the latter state is at this moment considering a report in which immediate construction of the tunnel is urged. The time is at hand when the National Government must act to share in the planning and execution of the work, to review and restudy the plans with regard to the interests of the whole country, and to push the undertaking toward early completion with all needful resource and determination.

But the planning of such a crossing must be governed by the interests of the entire nation. Projects worked out hitherto have been based on local needs alone. The Government's immediate participation in the enterprise is necessary if the maximum efficiency of New York harbor, considered as the chief port of the country, is to be secured.

Are Highway Engineers Neglectful of the Importance of Drainage?

MORE than the elements of truth lie in the following words, which are buried in A. A. Young's article on p. 543: "A man who cannot properly repair a dirt road does not know enough to build one; a man who does not know enough to build a dirt road does not know how to repair a gravel or macadam road; and a man who does not know how to repair a gravel or macadam road does not know how to build one."

The generous and genuine attention given to the necessity for a surfacing which will withstand the destructive effect of motor driven traffic has, to some extent, lightened the accent which engineers place on drainage. They have been face to face with a new problem of growing size and unusual importance, and

perhaps have felt that such primary facts as drainage, being so well known, were taking care of themselves.

Probably this has not been true in some locations for several years, but in spite of the intensity of Mr. Young's attack, it must not be overlooked that the state highway engineer of Missouri said, at the recent convention of the American Road Builders' Association, that he "would like to see the word DRAINAGE printed in every known language and pasted in the hat of every man connected with road work," and that the first deputy commissioner of highways of New York State said, in a lecture given at the Michigan University Road School, "More complete drainage should be procured. This is not exactly a novel proposition, but will stand reiteration unto the thousandth time."

Railway Track Progress in Sight

THE remarkable investigation of stresses in railway track reported in last week's issue not only lays a secure foundation of test knowledge for the future development of railway roadbed but it furnishes results that have immediate practical value. Most important of its effects is that it brings the rail problem—still the most urgent of all track questions, as it was five years ago—nearer to its solution.

Rail troubles were painfully prominent at the time the committee was appointed. Some engineers laid them to excessively severe service in the track; others blamed defects in the steel for most or all of the failures occurring. Since that time the track-stress committee has measured rail stresses, and another committee has carried on statistical and laboratory studies of failures, with relations to rail-steel quality—the rolling-mill phase of the question. The track-stress investigation is the first to show definite results.

The measurements establish the fact that the load stresses in rails are quite low. Even under heavy freight engines they do not much exceed 20,000 lb. per sq.in. in the flanges of the rail base. This holds with remarkable generality for good track, well maintained and free from local defects. The tests were made under such a wide variety of conditions that they may fairly be said to cover all normal railway track. The results are reassuring. They furnish no support for claims of excessive rail stresses in good track.

But defective track conditions, we also learn, increase the stresses considerably. In view of this fact we may for the present consider the rail problem referred back to the maintenance engineer and the rail manufacturer.

However, the effect of permanent stresses—internal strains in the rail—must not be left out of account. Such stresses exist in every rail. They have been measured in a number of cases during the last five or six years, in the investigations made by J. E. Howard for the Interstate Commerce Commission. The strains were frequently high, but as they do not seem to follow any recognized law in their distribution and amounts it is not possible to draw any broad conclusions as yet. Many additional measurements will have to be made. For the present it is well to bear in mind that Howard found some strains approaching the figure of 20,000 lb. per square inch.

Until more is known of how the two kinds of stress combine, what effect is produced by alternating stresses in the rail and whether recovery from internal strain takes place, specific use can not be made of the strain measurements. But the certainty of a considerable stress increment through internal strain emphasizes the importance of avoiding defective track conditions. If lack of tamping increases the service stress by 6000 lb. per sq.in., a high standard of maintenance appears absolutely essential to railway safety.

The really large result of the committee's research, however, lies in the discovery that railway track can be subjected to scientific analysis. The elastic action of the structure is of such nature that precise calculations of rail stresses as well as other physical quantities can be based on it. The substitution of measurement and definite theory for merely qualitative observation and general reasoning clears the way for progressive improvement of railway track in strength and efficiency.

That the test results are in complete harmony with the empirical conclusions of the past is therefore the more gratifying. New meaning is given to some existing views, however. For example, the principle that rigidity is the prime quality of railway track is emphasized in a way that makes it almost a new article of track faith. We know now that rail is safer on a stiffer roadbed.

Anticipation is likely to be even more live, now that the first track-stress results have been reported, than it was before the report. We have learned that results of practical value can be obtained. There is promise, then, that the lateral actions in rail will be measured and explained, that we will learn about the service of the spikes, the effect of curves, engine nosing and the like. Further, the rail-joint problem is ever before us. Knowing that bending stresses are developed continuously along the rail, we want to see what demands they place on the joint bars and bolts. Equal curiosity is excited with respect to the stress increase due to speed—a phenomenon which the committee has left unexplained, even to the extent of omitting all results of track-depression measurements under moving locomotives. The influence of counterweight unbalance—a matter of constant interest to railway bridge engineers—also awaits study.

Questions of many kinds remain to keep up active interest in the committee's work. What has been done so far warrants the hope that the entire investigation will be of service in the development of the future ideal railway track. In the meantime, however, data enough are placed in our hands to engage the fullest attention of every track man, with a view to their immediate utilization. It is not too much to expect that even within the current year our railway track will be made distinctly better—safer and more efficient—as a result of the investigation reported.

Public Health Service Appeals for Men

THE official appeal for engineers to aid the United States Public Health Service in its fight against malaria-bearing mosquitos in the vicinity of military camps printed on p. 581 of this issue will doubtless be met with a prompt and hearty response. Engineers experienced in land drainage would perhaps be most useful, but the essential qualifications are ability to run grades and direct ditching and filling operations.

Improper Drainage the Cause of Most Highway Failures

No Hard Surface Should Be Constructed Until Entire Road Has Been Under Constant Maintenance Long Enough To Indicate Weak Spots

By A. A. Young
Jewett City, Connecticut

BECAUSE of the grumbling about taxes and the enormous sums appropriated for highway work this question suggests itself: "Is the public getting a fair return for the money spent and being spent on state highways?" After more than 10 years use and careful study of highways, the writer is convinced that 25% or more of the money spent on so-called state roads is wasted, and that it is high time the thoughtless methods of road construction were abandoned and a sane and reasoning policy adopted.

In this article the writer hopes to bring to the attention of engineers having charge of "state-road" work some of the places where money is wasted, and at the same time invite attention to methods which always lead to more durable foundations. It will be necessary, to make the article clear, to cite some specific examples of wrong and poor methods, and it is earnestly hoped that readers will realize that no attack is intended against an individual, but that the criticisms are of the *methods*. With very minor exceptions, the same methods are used in all the New England States with which the writer is familiar, but the article should apply to New York and Pennsylvania, because those states have very much the same geologic formation as New England.

In the opinion of the writer, metalling, and the care of it, is entirely distinct and separate from the foundation, and it is principally the foundation and its formation with which this article deals.

For brevity "highway" will be used when mentioning that part of a state road system already improved, and "road" for all unimproved ways.

Experience has shown that very few miles of highway in New England stand up to carry their loads twelve months of the year. During one to three months, according to the weather, the highways are badly rutted and in places unfit for use. Such conditions existed when only pleasure cars were used, and little was said about the condition, because the travel was mostly for pleasure and the people were used to having roads "rut-up" in the spring and mild winters. Now the motor truck has arrived, and the poor conditions of the highways are complained of because they interfere with earning power.

UNDRAINED, BOGGY SUB-GRADE—RUTTING INEVITABLE

In the early days of highway building by the states the work was done to get an even riding surface for the pleasure automobile, and no thought was taken of foundations because, as already remarked, the people expected to be deprived of the use of the highways in the spring as they always had been deprived of the use of the roads.

As the automobile developed and the weight of the cars increased from 1000 to 4000 and 5000 pounds, at the same time the people began to use their cars more months of the year—plowing through the soft places in spring as best they might—with the result that the road men found their highways were being wrecked. Attacking their problems along the same lines which had brought state highway commissions into being, the engineers sought for a stronger metalling for the surface, even going so far as to use reinforced concrete, but calmly, or carelessly, ignoring the axiom regarding a material which when dry will carry its load, but when saturated with water would give way. That axiom may be stated: *Remove the water at all times and the road carries its load at all times.* All our highway problems have, up to date, been handled in a most superficial manner so that now, when the need is here, the people begin to realize that highway building is something more than grades and surfaces; but will the engineers ever wake up to the fact? I have seen reinforced concrete slabs on highways raised inches by the freezing and thawing of the ground water.

And so it goes in highway construction and maintenance. Not a new idea or method introduced. High-salaried engineers constructing and repairing highways along the same lines that their grandfathers and great-grandfathers did. No careful thought is given to the question of foundations. If settling occurs, fill it up. If the highway is soft in spring for a few rods, build miles of reinforced concrete road surface so as to have something which will *bridge* that soft spot. No real advance over grandpa, but oceans of money. The writer has yet to hear a highway engineer tell why he does not use underdrains, and also he has yet to learn why highway engineers do not like to discuss underdrains.

There are in one New England state a few hundred feet of underdrain in the highways, but it is of the crudest and oldest type known—and much of it is not working. Perhaps because it is not working the state engineer condemns the whole principle of underdrains. These old-styled underdrains were made by setting two flat stones on edge and covering them with another. The water carried by the drains so formed flowed on the ground in which the drain was placed;

a soft place occurred, and in a short time a portion of the drain dropped down and the drain as a drain was no more.

Careful observation leads the writer to believe that at least 15% of the highways in New England should be underdrained, but he also believes that there is less than one mile of modern underdrain in all six states.

One state is beginning to see the need of heavier highway construction and is introducing some telford bottom where the soft places are in the spring. (Speaking of telford, how many highway engineers can tell why telford bottom was introduced?) On an auto trip last summer I saw telford bottom being placed on as fine a gravel foundation as could be found anywhere, around the points of hills, at an expense of thousands of dollars, where a few hundred dollars spent on underdrains would have given better results, because they would be permanent; whereas the telford, because of the location, will fail sooner or later just as the macadam roadway has already failed. Did a highway engineer ever place a few pebbles on a muddy spot and then jar the mud slightly and watch the pebbles disappear? That is just what happens to macadam under the jarring of trucks and automobiles and just what happens to the telford sooner or later.

Within a mile of where this is being written, a piece of highway costing $5000 per mile so broke down the first spring, from ground water, that horsedrawn vehicles went down till the axles rested on the ground. A few hundred feet of underdrain would have taken care of the ground water and saved the road. As it is, the $5000 spent on this road is more or less wasted because of mud in the winter and spring.

CONDITIONS HERE ARE IDEAL FOR RUTTING

Another highway, costing something like $12,000 per mile to build, has in springtime a flowing spring right in the middle of the roadway. Needless to say, that piece of highway becomes rutted. The writer endeavored to have the state engineer put in an underdrain at this point as an experiment, but his good intentions were brushed aside by the remark, "That is caused by the conditions." The "conditions" are there every spring, and we unfortunate antomobilists, who pay a large road tax for good roads, wallow around it as best we can. No appeal; it is muddy because of "conditions."

The cross-section above is of the highway section within twenty rods of the above-mentioned spring, and the state road men wonder why it is rutted every spring.

Ten or a dozen miles from here is an important highway on which is a section, half a mile or more in length, which is fairly boggy, open winter and spring, because of the condition of the ground. The photograph shows the location of this piece of highway to be alongside and near the foot of a large hill. A 4-in. tile drain, properly laid, would keep the ground water out of this piece of road, and it would be as firm in spring as in summer. What proof is there that a drain would make this piece of highway firm in spring? The fact that at each end of the piece, where the underlying material is open and more porous, the highway *is* firm and not troubled with rutting.

No Drainage Makes This Highway a Quagmire

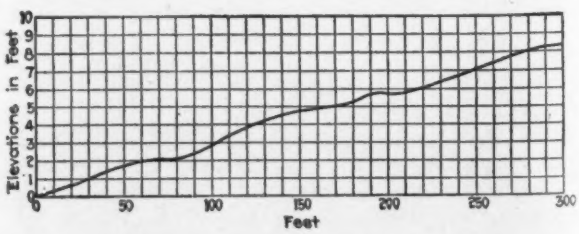
Not far from here a highway is being constructed on a road which has always been a quagmire in spring. The location is similar to the above-mentioned highway —on the side of a hill which is full of water in the spring. No drains are being considered for this section, and the highway is doomed to failure from the start. However, cost of "repairs" will not show against the cost of construction, nor will the cost of repairs show against this section after completion, because it will be distributed over all the roads in the vicinity. As the road surface is rutted and sinks out of sight, haul on more metal and more metal till the metal of the highway finds some sort of resting place. Even a farmer could do this, if given money enough.

A glaring example of bad judgment, or entire lack of judgment, in highway engineering occurred recently on a highway crossing a sort of tableland.

At one point near the edge of the tableland is a small pond every spring. Opposite this pond the roadway is somewhat above the pond level, but in a few rods the grade of the highway carries it below the pond level. At this point "conditions" were evident last spring, and many automobiles and wagons were mired. This mudhole was the weak link in 70 miles of truck highway!

After a time the highway "engineers" got busy and began hauling in rocks and gravel to cover the unsightly spot. The old surface was buried to a depth of 5 or 6 in., but the pond was higher than the new surface and the water came right up through the new work. In a week or two kind old Dame Nature drained off the water, and the highway was again firm and usable. More than a hundred dollars must have been spent on this and another mudhole near by, when a good man with a pair of horses and a split log drag could have put the highway in as good shape in two days.

A very interesting example of the effect of ground water on the foundation and consequently on the surface has developed near here while this article is being written. The profile illustrates the heaving into undulations of the highway. As will be noted, the profile covers only about 300 ft. of the highway, but the undulations show plainly for more than an eighth of a mile. The heaving has occurred during a long period of cold weather, and one can imagine the condition this



IRREGULARITY OF ROAD PROFILE THE RESULT OF FROST ACTION ON GROUND WATER

highway will be in for a longer or shorter time when the undulations are settling into place with the recedence of the ground water. When it is remembered that the frost in this section is 4 ft. deep, a faint realization of the force of ground water may be gained.

A man who lays claim to the title "highway engineer" should acquaint himself fully with the condition of the road he is to rebuild. A road which is soft in spring and firm in summer should be properly drained before any other improvement is started.

"It is easy to criticise," but sometimes criticism is necessary to attract interest. Without a doubt, when the American highway engineers really attack road problems as they do other problems of their profession, we shall enjoy as fine highways as can be found.

It is unfortunate that an engineering education tends to narrow-mindedness, and it is more unfortunate that engineers should have carried that trait into highway supervision. The highway problem of the states is a large one and should be attacked in a very broad-minded manner, or failure is sure to result. The confronting questions are well worthy the most careful attention and thought of our ablest men. State commissions and engineers should realize that simply improving a (comparatively) few miles of highway does not solve the problem, nor does it even approach a solution. There should be, there must be, a much broader grasp of the situation before any real progress can even begin.

Must Face Question Squarely

Facing the question fairly and squarely, in its broadest sense, can state highway engineers honestly say that present highway methods are a success; must they not acknowledge at least partial failure? How many miles of highway in New England can be *guaranteed* for use of even pleasure cars twelve months of the year?

So far, the improvement of a few miles of road by the state has resulted in the neglect and almost abandonment of many miles of roads which may be very important to the country and its centers. Lavish expenditure of money on grading and surfacing roads which, as highways, show the same faults which existed in the old road, tends to discourage any attempt by local workers to better the roads under their charge. Local road-workers are not shown a single new idea whereby the natural material of the country might, at less cost, be made to provide better transportation facilities. Local taxes increase to support a mile or two of "trunk line" and the network of roads which made the town are neglected until living remote from a state road is next to impossible. People who live away from a highway exist with the hope that the state will some day improve their road. For 75% of the farmers this hope is an illusion because, based on present costs, there is not enough available money to improve 25% of the roads.

The taxpayers realize that *highways* are becoming a burden, as the *roads* have been for years.

State highway engineers should so plan the work of improving roads intended for highways that the local workers could see the results of improved and advanced methods and become interested in adopting the same methods on their roads. The transition of a road to a highway should be a natural sequence—draining, grading, compacting and shaping the foundation; then placing whatever metal was found necessary to stand the wear and tear of traffic. A foundation properly prepared, by proper methods, would be an eye-opener for thousands of road-workers and should tend to the production of better roads for the use of the millions of rural dwellers.

If the writer's criticism of methods and results has interested any engineers, they may like to know if the author has any solution for highway problems.

Engineering Competency Defined

Some years ago the writer made this statement: "A man who cannot properly repair a dirt road does not know enough to build one; a man who does not know enough to build a dirt road does not know how to repair a gravel or macadam road; and a man who does not know how to repair a macadam road does not know how to build one."

Very few highway engineers have ever worked on dirt roads or directed work on them. Get down to first principles. Let a highway engineer take a 3-mile section of road and direct all work on it for a year; watch the condition of the road at all times, and he will know more of highway building than the vast majority of state engineers show signs of knowing today. At present, if the state decides to improve a certain road, a small section of it is improved each year. That part which is to be improved in future years is left to wreck and ruin, with the result that a road once in passable condition is practically impassable because a mile or more has been improved.

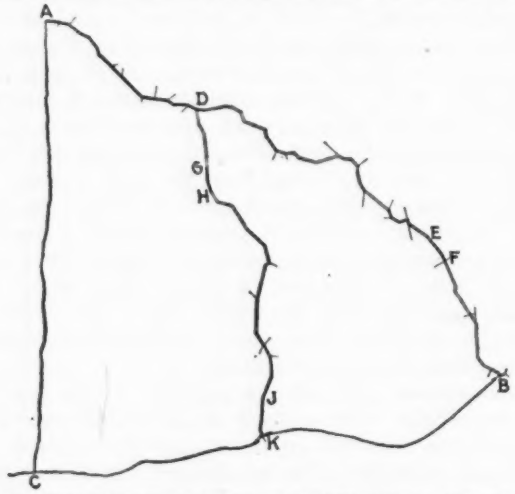
Now suppose that when a road is selected for improvement the state engineer should immediately take over *all* the road and repair it. Let the highway department spend the same thought and care on that road that it does on the highways. Result? The soft places would be found and would be remedied by underdrains or other methods, grades would be lessened, rocks removed, the roadway widened, a firm foundation for the highway prepared, and at the same time the public would be getting a better road all the time. There can be no better method devised for securing a firm highway foundation than by grading in light lifts and packing these lifts by the traffic of the road. What engineer would think of putting all the earth filling of a dam in place at once and then rolling the top of the pile? And yet that is just what most highway engineers are doing today in their grade fills. No foundation should be considered fit for metalling until it had carried its traffic for at least two years. By following the scheme of highway building outlined above, state engineers and their assistants would be familiar with every rod of road and have the foundation perfect when the metalling is to be placed. They would also be amazed to discover how many miles of highway could be cheaply constructed by simply draining properly and treating the surface as gravel highways are now treated.

Under this scheme of the state taking over the whole length of road to be improved and working it with a view to making it the foundation of the future highway, there would be obviated the enormous waste of money spent on unlinked-up highways, which are useless for really practical purposes.

In one state the writer is familiar with, the highway department has spent thousands and thousands of dollars constructing a highway from W to HH. From HH to B are five miles of the worst "hogwallow" and rocks imaginable. Unnecessary to remark that nearly all the money spent on the highway from W to HH is wasted, because it cannot be utilized to the extent indicated by its cost.

Another instance: The same state has spent many thousands of dollars on the highway from W to S; from S to C is another stretch of road indescribable, and which will not be improved for years. From C to P more thousands have been put into highway. Not all of these thousands in highway from W to S and from C to P are wasted, but in comparison to cost and practicability the waste is enormous.

As an actual instance where improving a few miles of road resulted in actually diverting traffic from the highway and road intended to be improved, the accompanying map is interesting.



IMPROVING SHORT SECTION STOPPED LOCAL WORK ON UNIMPROVED PARTS, DIVERTING TRAFFIC

The route under consideration is from A to B. Formerly this road was in fair condition, but three or four years ago the state commissioner decided to improve it. A small section from E to F had already been made a highway, though it rutted badly every spring.

As soon as the state began improving the section from A to D, the local workers practically stopped repairing that part of the road from D to E. As a result the road went to pieces and because of rocks and ruts became unfit and dangerous for travel. The fine highway from A to D invited many autoists to attempt the trip, but a few narrow escapes from collision and increased tire wear from rocks soon dissuaded them, so that travel which used to pass from A to B direct now takes the circuitous route A—C—B. The spending of thousands of dollars on the highway from A to D, while leaving D to B to take care of itself, has actually resulted in forcing traffic from the road.

An almost absolute and criminal waste of money on the road from D to K is seen in the construction of a highway from G to H. Some $4000 or $5000 must have been put into this highway from G to H, and it is almost impossible to get to it at any time of the year. Rocks and rocks block one end of the approach, and rocks and mud the other. Yet the autoists are liberally taxed for this highway which they practically cannot get to.

Now supposing the state, when deciding to improve the section from A to D, had first taken over the whole road from A to B, repaired it with a view of forming a foundation for a highway, worked out a good subgrade, kept it properly shaped up, properly drained the soft places and widened the roadway to the proper width. The public might have been out a mile or so of *highway*, but for five or ten years would have enjoyed much better traveling from A to B than it had ever known; and, at the same time, there would have been formed a stable foundation which would be capable of sustaining whatever metalling might be placed on it. What is the sense of building miles of expensive highways which have one end in a mud-hole or rock-pile?

To sum up: Because of the formation of the terrain in the northeastern states, no engineer (unless he is omniscient) can sit in his office and draw proper specifications for highway foundations.

The making of the foundations should be under the care of his most careful and skillful assistants, and the work should not be hurried. The foundation should be firm enough to bear its load at all times.

As the work of making the foundation proceeds, all ground water which is at all troublesome at any time of the year should be removed by drains wherever possible.

Except in cases of heavy rock-cutting, the road under improvement should be open to passage at all times. Should it be necessary to close the road for a time, a suitable detour—kept in good shape—should be provided. The traveling public should not be turned into cow-paths and mudholes as at present.

Until highway work is carried out on lines similar to these suggested, the highway problem will remain as unsolved as it is today.

Sir Walter Raleigh covered a mud-puddle with his velvet cloak that his queen might pass dry shod. Has the modern highway engineer done much more for the users of our highways?

Many Traction Engines Used in Kansas

On Mar. 1, 1917, 4032 traction engines were in use in Kansas. It is estimated that 6000 to 7000 are now in use. The average drawbar horsepower of the traction engines in use is 12.5 which is equivalent to about 25 brake horsepower. The size most commonly used develops about 20 horsepower. The average owner used his tractor 40 to 50 days last year. The majority of Kansas traction engines are propelled by internal combustion engines using gasoline or kerosene for fuel. Steam traction engines are used to a limited extent for threshing and other heavy belt work. A large average was planned by traction engines in 1916.—From the report of the Committee on Mechanical Engineering, Kansas Engineering Society, Jan. 16, 1918, presented by Dean A. A. Potter, of Kansas State Agricultural College.

Year's Work of Railway Engineering Committees Reviewed

Brief Summarization of Reports Submitted at Nineteenth Annual A.R.E.A. Convention, Held This Week in Chicago

FOLLOWING are summarized the reports made by its committees to the American Railway Engineering Association, in convention in Chicago this week. The reports have been appearing for several months in the association's bulletins. The summaries are brief, and as they were prepared in advance of the convention they take no account of the convention's action on them. An account of the convention will appear in next week's issue, and in this and succeeding issues will be found more extended abstracts of some of the reports.

Roadway

Ten conclusions relative to the drainage of roadway through stations and yards are submitted by the committee on roadway. The conclusions relate to open ditches and drains of various types according to the conditions.

No conclusions are reached as to the committee's other assignments. (Bulletin 203.)

Ballast

Three ballast sections for 24-in. depth under the tie are recommended by the committee on ballast. They apply to single track on tangent, double track on tangent and single track on curve. Each shows 12 in. of sub-ballast and 12 in. of top ballast. The committee feels that Class A track should have 24 in. of ballast under the tie, but is not ready to make general recommendations as to the proper depth of ballast of various kinds to insure uniform distribution of loads on the roadway.

Other recommendations for the *Manual* include seven new definitions, and matter relating to physical tests of ballast. Considerable data are presented on methods and cost of applying ballast, account being taken of organization, use and limitation of tools and ballasting by contract. Diagrams for the disposition of forces, as secured from a few roads, are shown, but the committee has thus far had meager responses to its inquiries along the line of organization. The committee interprets the consensus of opinion as being strongly against ballasting by contract in normal times, especially on an operated track.

The committee has brought up to date a general bibliography on ballast and ballasting made in 1906 in the library of the American Society of Civil Engineers. It also presents as a matter of interest the specifications for stone ballast of the Pennsylvania lines west of Pittsburgh. (Bulletin 204.)

Ties

A progress report on methods in use by various railways for controlling tie renewals, showing the answers to a questionnaire addressed to the railroads, is submitted as information by the committee on ties. The committee also presents the usual report—25 pages in this case—on trials of substitute ties, and reports progress in its study of the effect of tie-plates and track spikes on the durability of ties.

Because it has found that no railroad is using Forms M. W. 301, 302, 303 and 304, "Statistics of Cross-Ties," the committee recommends that they be withdrawn from the *Manual*. (Bulletin 203.)

Rail

The specifications for high-carbon steel and neat-treated, oil-quenched steel joint bars submitted a year ago are recommended by the committee on rail to supersede those now in the *Manual*. Likewise the specifications for quenched carbon and quenched alloy steel and for medium carbon steel track bolts with nuts, submitted last year for consideration, are recommended, with certain changes, for adoption in the *Manual* in place of the "Specifications for Track Bolts." As another revision in the *Manual* the committee would eliminate one—that in the flange—of the three borings for chemical analyses of rails, and modifications of the details of tensile-test specimens to permit any form which will fit the holders of the testing machine. This is in accord with the standard of the American Society for Testing Materials.

Rail-failure statistics presented in an appendix continue to show decreased numbers of failures on any basis of service; the committee ascribes the improvement mainly to the gradual replacement of bessemer with open-hearth rails, the adoption of heavier rails with stronger bases and the improvement of the metal.

Other special investigations are reported in appendices by M. H. Wickhorst on mill inspection in 1915 and 1916, on influence of gage length on elongation in drop test, and on tests of manganese steel rails; by Dr. P. H. Dudley on inhibited or delayed transformations in rail-heads, and by a subcommittee on intensity of pressure on rails. (Bulletins 199 and 203.)

Track

Specifications for relayer rail and a design for cut spikes, the latter slightly modified from that referred back to the committee last year, are recommended by the committee on track for adoption. A number of slight changes in the *Manual* are also proposed.

As a basis for discussion plans are submitted for typical layouts of a No. 10 turnout and a No. 10 crossover for two styles of 16½-ft. split switches and for Nos. 6, 8 and 10 rigid frogs. These latter are developments of the types in the *Manual*.

An appendix in the committee's report gives as information data regarding reduction of taper of thread of wheel to 1 in 38 and canting of wheel inward. The committee's present view is that best results from both wheel wear and rail wear will be obtained if the rail is so installed and maintained as to provide a uniform bearing. Another 5-page appendix discusses the effect of fast trains on the cost of maintenance of way and equipment. A diagram shows the effect of density of traffic and proportion of passenger traffic. The committee asks more time, however, for further investigation.

In the matter of whether widening of wheel flanges would be detrimental to the present standard of track construction, the committee thinks it would not provide certain precautions, which it enumerates, were observed. (Bulletin 202.)

Buildings

A 22-page discussion of provisions to insure safe walking in and about passenger stations is presented by the committee on buildings. The pages include general recommendations to safeguard pedestrians in connection with the construction of new passenger stations and the maintenance and alteration of old ones, and specific recommendations covering safety provisions for stairways at passenger stations.

In a short discussion of the relative merits of high and low station platforms, the committee finds both advantages and disadvantages in high platforms, but urges that all cars in future be so constructed that they will fit either high or low platforms.

Three pages of definitions are submitted for consideration. (Bulletin 209.)

Wooden Bridges and Trestles

Six conclusions relative to the use of lagscrews in trestle construction are recommended for adoption by the committee on wooden bridges and trestles. In an appendix the committee's findings are set forth at greater length. The conclusions are in favor of the use of lagscrews as being as serviceable as bolts and nuts, and cheaper to maintain.

On the subject of the comparative merits of ballast and reinforced-concrete trestles there was much discussion at the convention last year of the committee's conclusion that "creosoted timber trestles are more economical than concrete, except when the cost of the concrete structure is less than one and one-half times the cost of the wooden structure." The committee this year presents a 19-page discussion of the relative merits of the replacement, capitalization and sinking-fund methods of determining the relative economy; the committee favors the capitalization method, and uses it to justify its renewed recommendation that the conclusion under question be adopted. (Bulletin 204.)

Masonry

A 44-page report is submitted by the committee on masonry. The subjects discussed are concrete piles, concrete culvert pipe, typical designs of foundations in various soils and depths of water, and the wisdom of using blast-furnace slag in reinforced-concrete work. The appendix devoted to concrete piles embraces both pre-molded and molded-in-place piles, and includes specifications for constructing and for driving pre-molded piles. Nine conclusions on the subject of foundations are presented, together with a four-page bibliography. The experiences of several railroads in the use of slag in reinforced concrete are presented, the committe summarizing them in six conclusions.

Under the heading of concrete culvert pipe are given specifications for its design and construction, together with drawings and tables showing the details of pipe of various sizes used by a number of railroads. (Bulletin 204.)

Signs, Fences and Crossings

Fifteen conclusions recommended for adoption in the *Manual* summarize an 11-page discussion of concrete fence posts by the committee on signs, fences and crossings. The discussion includes comparison of different types of posts, and data on end or strain posts. Six photographs are also submitted to show different types of fences, other than concrete, to supplement the matter on right-of-way fences now in the *Manual*.

The committee makes recommendations covering widths and depths of flangeways for straight and curved tracks. There is also presented a seven-page table showing the practice of steam and electric railways throughout the country.

Information is presented showing the legal requirements in each state regarding grade-crossing elimination—the method of procedure to eliminate a grade crossing, and the distribution of the expense. A table is presented showing the requirements of the various states in the matter of fences and stock guards. There is also presented a short discussion of the principles of the design of signs and rules for their use. (Bulletin 204.)

Signals and Interlocking

A report is made by the committee on signals and interlocking on the feasibility of separating into distinct types of their own (a) the signals for train operation and (b) the markers or signs which indicate the location, position or both of signs and switch signals for conveying information to trainmen. Eleven designs of signs are submitted; they pertain to speed limitations, the proximity to stations, crossings or the like.

Five plates of symbols are also recommended for adoption—one containing new symbols and the others substitutions for those now in the *Manual*. There is also submitted as information a list of findings, conclusions, standards and specifications adopted last year by the Railway Signal Association. (Bulletin 201.)

Records and Accounts

Only one recommendation is made by the committee on records and accounts; this is that the specifications for maps and profiles, submitted last year as information, be adopted for the *Manual*. Progress is reported on various investigations, notably subdivisions of I. C. C. classification of investment in road and equipment; cost-keeping methods and statistical records, and allocation of maintenance-of-way expenses to passenger and freight traffic. The committee has obtained a large number of valuation forms for both field and office use, and suggests that they be filed in the office of the association for the use of anyone interested. (Bulletin 202.)

Rules and Organization

Progress only is reported by the committee on rules and organization. The committee presents a 12-page bibliography on the science of organization. It points out that little has been done with the subject since it was first assigned to the committee five years ago, because of lack of interest on the part of the association. The committee thinks there could be a series of monographs presented by the members—abstract and

scientific in the beginning, later on pertaining directly to the practical and important application of scientific principles to railroad operation. (Bulletin 204.)

Water Service

A set of rules or examination questions for the care of boilers in pumping stations, and a list of 51 definitions of terms used in railway water service are recommended by the committee on water serivce for adoption in the *Manual*. The committee also proposes extensive revision of the subject matter now in the *Manual* on water service.

Appendices are submitted as information on the relative merits of continuous and intermittent water softeners, on organization for railway water-service departments and on the pollution of wells from overlying or adjacent cinder deposits. The committee states that it has gathered a large amount of information on the design of impounding reservoirs. (Bulletin 202.)

Yards and Terminals

As noted editorially in this journal last week, the committee on yards and terminals has during the last year been giving much attention to the possibilities of war-emergency yard improvements. The committee recommenrds that each road create a small committee to make a detail study in the field of each yard. By way of suggestion of what might be done the committee has prepared a catechism of 25 questions. A fuller account of the committee's work along this line, together with the catechism, will be found on another page of this issue. The committee also points out the special nature of the problem of ocean terminals which require extensive construction that may be of a more or less temporary nature.

The committee has also brought up to date its cooperative work with the American Railway Association on the subject of track scales. The committee recommends for adoption track-scale specifications and rules and submits as information data on equipment for testing track scales and on scale test cars. (Bulletin 203.)

Iron and Steel Structures

Three conclusions in the matter of the strength of columns are recommended for adoption by the committee on iron and steel structures. They are based on a continuation of the tests made by the U. S. Bureau of Standards, on which the committee offers as information a 33-page report.

Specifications for bronze bearing metals for turntables and movable bridges are recommended for adoption, as is a conclusion that the Schoop metal-spraying process does not afford satisfactory protection from corrosion. A 48-page set of specifications for movable bridges is submitted for consideration a year before adoption. A report on impact tests on the electrified section of the Chicago, Milwaukee & St. Paul Ry. is presented as information. (Bulletin 204.)

Electricity

Nothing is recommended by the committee on electricity for adoption in the *Manual*. A considerable amount of matter is offered for publication in the *Proceedings*. This includes a list of electrical definitions; a seven-page table of third-rail clearances on various roads, and a report on the national electrical safety code. The committee presents general conclusions that the code is acceptable and desirable in the main, but regards as deficient a number of the sections pertaining to overhead and underground lines for electrical transmission, and desires that the legality of the code be established by a high Federal authority.

As information, data are presented bearing upon the question of the proper type of overhead catenary construction. The committee urges the special desirability at this time of investigation of the possibilities of water-power development in the territory of the railroads, and suggests underlying principles to govern such an investigation. The committee sets forth developments of the last year on the subject of the action of salt water on concrete, and calls special attention to the series of articles in *Engineering News-Record* last September and October. (Bulletin 204.)

Conservation of Natural Resources

Information only is offered by the committee on conservation of natural resources. Appendix A is a 10-page digest by Dean J. W. Votey, of the committee's previous reports. Appendix B, which has eight pages and constitutes the remainder of the report, relates the progress being made in Canada in conserving and utilizing the natural resources of the Dominion. (Bulletin 202.)

Uniform General Contract Forms

The committee on uniform general contract forms, made a standing committee since the 1917 convention, presents an industry-track agreement and an agreement for interlocking plant. In neither case is provision made for division of expense or responsibility for maintenance, the committee believing it to be preferable to leave these details to be filled in in each case by the interested companies. The committee submits and recommends, however, a basis for division of cost of construction and maintenance, and ownership of industry tracks. (Bulletin 203.)

Economics of Railway Operation

In this, the first report of the new committee on economics of railway operation, the committee discusses at some length what it regards as its function. Overlapping of the field of the committee on economics of railway location is recognized. Says the report, "it was decided [at the committee's first meeting] to be the sense of the committee that its scope or field include all matters affecting the operation of a railroad; but that for the present the committee confine its efforts to developing economy of operation of existing plants, including such additions as may be necessary for economical operation, but not including changes in alignment or grade reduction."

In addition to this discussion of its scope, and outline of what it hopes to do, the committee presents a 39-page bibliography. (Bulletin 203.)

Economics of Railway Labor

A 27-page bibliography also constitutes a part of the first report of the new committee on economics of railway labor. In addition there is presented a 6-page discussion of methods of securing labor, and a 36-page dis-

cussion of the problem of feeding and housing, maintenance-of-way and construction employees. The latter includes numerous extracts from the experiences of various railroads, a table summarizing the replies to a questionnaire and abstracts of laws on the subject prevailing in several states. (Bulletin 202.)

At the time the foregoing summaries went to press the reports of the standing committees of the association on economics of railway location and wood preservation and those of the special committees on grading of lumber and stresses in track had not been received.

Committee Approves Emergency Contract Form of Quartermaster Corps

War Department Calls in Body Representing Engineers, Labor and Business, Which Finds Cost Plus Sliding Scale Fee Basis Best for $668,000,000 Program Yet To Be Completed

UNQUALIFIED endorsement was given the revised form of emergency contract covering the latest cantonment work by a special committee of engineers, architects, business men and contractors, which was called by the War Department to advise upon the greatest building construction program of modern times, involving $668,000,000 still to be spent in new construction. This work, which is in immediate prospect, includes storage terminals, ordnance depots, housing for the Shipping Board, aviation camps, hospitals and other construction amounting to $278,000,000. It also covers forty additional housing projects for troops, amounting to $390,000,000. Including the work completed, under way, and in prospect, the War Department's gigantic program of emergency construction will aggregate $1,084,000,000.

The committee, which was called to advise the War Department regarding the best method of executing the new work, consisted of:

Professor A. N. Talbot, president, American Society of Civil Engineers, Urbana, Ill, chairman;

John Lawrence Mauran, president, American Institute of Architects, St. Louis, Mo., secretary;

John R. Alpine, representing the American Federation of Labor;

Frederick L. Cranford, president, General Contractors' Association of New York, Brooklyn, N. Y.;

Charles T. Main, president, American Society of Mechanical Engineers, Boston, Mass.;

Oscar A. Reum, representative of the president of the Building Construction Employers' Association, Chicago, Ill.;

R. G. Rhett, president, Chamber or Commerce of the United States, Charleston, S. C.;

E. W. Rice, president, American Institute of Electrical Engineers, Schenectady, N. Y.

The Cantonment Division Quartermaster Corps furnished the committee with complete data regarding the problems to be met in the Government work completed and under way. The various forms of contract, together with the objections and advantages of each, were detailed at length. Criticisms made both in Congress and by the contractors were presented for the information of the committee. Objections to the emergency construction contract, base upon a sliding scale percentage with a maximum upset fee, were outlined fully.

The form of emergency construction contract commended by the committee is the "third edition," in which the outstanding feature is that the maximum fee is made the fee shown on the sliding scale for the maximum estimated cost. Otherwise it is the same contract form under which all the cantonment work was carried out. Under this form the contractor must pay the "standard rate of wages" in the community in which the work is being done, unless he obtains the consent of the contracting officer of the Government to depart from the stanrard wage scale. A schedule of rental rates for all equipment, from typewriters to motor trucks, is listed in the contract.

In the original form of emergency contract the maximum fee was set at the fixed sum of $250,000 regardless of the cost of the construction. As pointed out by the War Department, criticism had been based upon the ground that this maximum fee put no obstacle in the way of profiteering in the smaller jobs.

Committees Report on Contract

The committee's report on this form of contract is, in part, as follows:

"Having advised therefore that these various forms be not used, and for the reasons stated, the committee unanimously concurs in advocating what may be termed the cost plus a sliding scale fee scheme of contract for both general contracts and subcontracts. In its general application it enjoys the same confidence in the building world as to the equities as does the lump sum contract, as is evidenced by its very extensive use. Its essential features are its applicability to projects great and small—its extreme flexibility with automatic adjustment of all variations in plan and scope. Under its terms the rates of pay for labor are known to be more equitable than under other methods. It requires for its successful application a painstaking review of the records and standing of contractors just as is now made under existing methods to insure the selection of an organization which measures up to the requirements of the contemplated project, but without working any hardship, since no one can escape the axiom that in the final analysis each job can go only to one contractor.

"The committee believes that one of the objections charged to this form of contract is that it encourages extravagance and holds open temptations to increase costs because such increase is accompanied by increased

compensation. The general form of contract now in use by the Cantonment Division in which the percentage decreases as the cost increases and is broken by fixed fees at intervals seems calculated to effectually check, if not prevent, this tendency. Moreover, under the contract proposed the Government retains the right to control the prices of most materials and of labor. Under these circumstances it does not seem to the committee that such an objection would have any force in relation to this form of contract. No reasonable objection can be pointed out by anyone possessing a full understanding of its equitable operation in practice, and finally this scheme appeals to the committee as possessing one qualification which must commend it to all thinking men—it permits starting actual work weeks and even months before the details are completely worked out and delineated and permits the Government to push the job at any speed it may elect, changing at will its plan and scope but paying only what the work actually costs, plus a fee which is so reasonable as to be above the reach of fair minded criticism."

In reviewing the various other methods proposed for handling the new Government construction, the committee pointed out the reasons why the "purchase and hire" method and the alternative forms of contract proposed would be undesirable. The administration of work under the "purchase and hire" method would involve, according to the report, the creation of an unwieldy organization at Washington. The vast amount of work in widely scattered locations would make a central administrative office impracticable, the committee decided. In the words of the report:

"It seems apparent that the valuable time lost in such process is an insuperable objection to this method. The committee believes existing contractors' organizations should be maintained and fostered, as they constitute in the opinion of the committee important factors in the economic life of the nation, and will be of exceeding importance to its progress when the war is over.

"The committee finding none of the conditions which would recommend this method of procedure present in the emergency construction work contemplated, and finding on the contrary many serious objections, advises that the 'purchase and hire' method be not used."

The "Lump Sum" Contract

Regarding the "lump sum" contract, the committee reported that under normal peace conditions this form would be highly desirable, but that it entailed waiting for drawings, specifications and bids.

"Thus would be lost those precious months which may be measured not in dollars but in lives."

The report continues as follows:

"The history of war emergency construction shows the development of many projects originally small by comparison into works of great magnitude and importance and for such development the 'lump sum' plan is too inflexible to operate satisfactorily; administration costs must increase in adjusting important changes, while inequities and dissatisfaction are bound to arise. In such an unstable market as exists costs must be figured by the contractor high enough to provide a margin to cover unforeseen and uncontrollable changes in the prices of material or labor, which would result in a speculative price which would be disadvantageous to the Government.

"Your committee advises therefore that the 'lump sum' method be not used."

In conclusion the report recommended the adoption of the existing form of emergency construction contract, with sliding scales of percentages and fees, for all the work remaining to be done.

Engineering Council Seeks to Unite Branches of Profession

To Harmonize Aims of Engineers, Interpret Them to Public and Strengthen Weakly-Held Fields, Says Secretary

THE aims of the Engineering Council, the first annual meeting of which was recently reported on page 430 of this journal for Feb. 28, as outlined in a statement by Alfred D. Flinn, its secretary, are to help engineers claim their share in public life, to develop meritorious projects for the general good of engineers or of the public, to take up the problems of those in new and weakly-held fields of engineering, and to centralize the efforts of engineers on those lines which are of common interest. Mr. Flinn's statement, telling also something of the work already undertaken, follows:

"The Engineering Council held its first meeting June 27, 1917. In the months which have elapsed, useful services have been rendered to the Government, to engineering societies and to individuals, and progress has been made in perfecting the Council's organization. Several important committees have been created and have accomplished much.

"The Engineering Council is an organization of national technical societies of America created to provide for consideration of matters of common concern to engineers as well as those of public welfare in which the profession is interested, in order that united action may be made possible. The Engineering Council is now composed of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, having a membership of 33,000 and known as the Founder Societies.

"Limitation of financial resources has been and still is one of the greatest handicaps. At the beginning of this year, an appropriation of $16,000 by the United Engineering Society, contributed equally by the four Founder Societies, became available for the period ending Oct. 31, 1918. Although this sum provides for the usual expenses of the secretary's office, for inaugurating several permanent lines of service and for a few special items in connection with the war, it is far from adequate. The Engineering Council is still forced to go slowly on work already undertaken and to decline or defer other meritorious projects. That the Engineering Council has accomplished as much as it has is due chiefly to the fact that individuals, societies and Government bureaus have informally contributed services and means. Additional income must be had if it is to bring to pass within a reasonable time many of the things rightfully expected of it for the benefit of professional engineers, the country, the Government and the public.

"Restriction of membership in the Engineering Council to the four societies mentioned is not intended. Quite to the contrary, it is planned and earnestly desired that other national engineering and national technical societies shall become affiliated, thus making the Engineering Council truly representative of the hundred thousand engineers in all branches of the profession throughout the United States. Conditions and methods for the admission of additional societies have been developed. Henceforth, a chief aim of the Engineering Council will be to increase the number of member societies and thus gain not only an enlargement of its capacity for usefulness along its chosen lines, but also greater technical and financial suport.

Activities Outlined

"So extensive is the field of possible activity for the Engineering Council that even yet it is unwise to set its bounds. Nevertheless, some of the proposed activities may now be outlined. Foremost among these is the fostering of a sense of solidarity throughout all divisions of the profession in all parts of the country—the increasing of a sense of common interest and of the strength that results from unification. To this end, subordination to the general welfare of the preferences and pride of organizations and of persons may be necessary; but it is confidently expected that even through difficult places the right paths will be found. Patience and good sense will win full and effective coöperation. Publicity of a high order, but of a practical sort, must be devised that both engineers and the public may be informed not only of engineering achievements in physical work, but also of the services which peculiarly pertain to engineers, in mental realms, those which they are performing and those which they should perform. Engineers and engineering must be made more comprehensible to the people up and down the land, and kept instructively and interestingly in the public prints.

"A most important service is the standardization of definitions, methods, requirements and tests for all varieties of engineering materials and work. Others are the improvements of the methods and requirements of engineering colleges, the standardizing of the meanings and values of the degrees given to graduates, and the broadening of the engineer through knowledge of humanitarian subjects, in which other professional men take interest.

"Mutual helpfulness in getting the right engineer for the empty niche of usefulness and in finding an empty niche for the unemployed engineer, or for the one seeking advancement, has for years been a need of engineering societies, widely voiced, especially by the younger men. Many endeavors have been made and are being made to meet this need, with more or less success; but most of them have been limited. Engineering Council has already given this matter much thought and has put it in the hands of the American Engineering Service, one of its committees. To meet these demands this committee has been assembling in its offices in the Engineering Societies Building, New York, comprehensive lists and much detailed information concerning engineers in all branches of the profession. During the past few months there have been supplied to the Government departments and bureaus several thousand names of engineers, from which men were selected to fill a great variety of positions in uniformed and civilian service for the Army, the Navy and other branches of the Government's activities in connection with the war, as well as for manufacturers and contractors engaged upon Government war work. Hitherto these war demands have absorbed most of the energies of this committee and its staff, but incidentally there have been accumulated great masses of live material which can in the near future be recast into a suitable mold of classification and indexed for permanent use. On methods of classifying and indexing the committee has already done not a little work. It is the intention to discover what has been done by others and so combine and strengthen all useful systems as to secure the greatest benefits for engineers, for employers and for local, state and national governments. It is the aim ultimately to create a complete, skilfully classified catalog of all American professional engineers.

Fields That Are Held Weakly

"It has become evident that although numerous engineering societies are occupying limited fields efficiently, and although some of these fields are extensive, there are large sectors of the domain of the engineer which are either but weakly held or else are usurped by others. This condition has arisen partly from specializing tendencies among societies as well as among individuals. Until the present time there has been no central agency capable of entering these sectors and competent to speak for the profession at large—no duly constituted representative to learn of the share in local civic and governmental enterprises which should be the engineer's, to claim it for him, and to see that he gets it; no organization to harmonize the action of the profession on similar questions in different localities; no interpreter to the public of the engineer, his work, his ideals and his methods; no body to develop meritorious projects for the general good of the profession or for the benefit of the public; no one constantly on guard to detect and oppose objectionable schemes and tendencies. To fill these gaps is the great aim of Engineering Council, not by demolishing any useful existing agencies, but by building these into a well proportioned and thoroughly furnished structure. Time will, of course, be required for erecting and perfecting such an organization with its necessary local branches covering all the United States.

"Engineers are organizers and should be directing their abilities as such to the greater service of the nation. No better demonstration of the need of such a centralizing body as the Engineering Council could be had than the multiplicity of existing engineering organizations, and especially the manifestation during recent months of this tendency to segregation exhibited in efforts to serve the Government in connection with the war. Order is slowly being brought into this confusion. but if the Engineering Council could have been well established before the beginning of the war, it would have become at once the connecting link between the Government and engineers, securing results quickly, directly, economically and in an orderly manner. While contributing its best endeavors to the winning of an early and complete victory, the Engineering Council must

be shaping its organization so as to be prepared to aid engineers in taking the leading part which must be theirs in the years that will follow the conclusion of peace.

"Unselfish service and mutual helpfulness must be the test requirements for all the undertakings of the Engineering Council. Offensive political or business activities must be avoided and the selfish aims of groups or individuals must not be fostered. If the work roughly outlined be carried forward in this spirit, no fears need be entertained for the profession's ethics, its honor, or the standing of the engineer in the community."

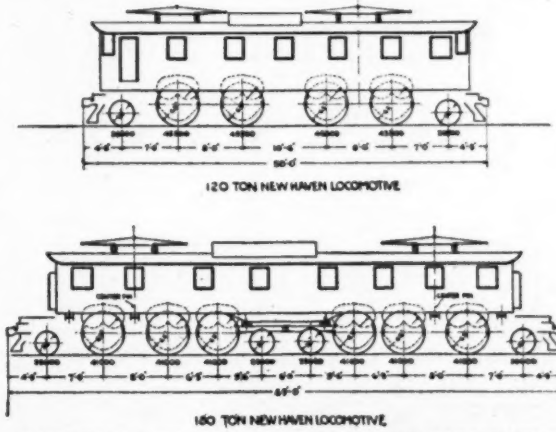
New Haven Orders Five 180-Ton Electric Locomotives

Will Haul Through Trains Over New York Connecting Railroad, Where Grades Are Too Heavy for Present Power

ELECTRIC locomotives have been ordered for several railroads surpassing in size anything yet built of their type. They were described Mar. 16 before the New York Railroad Club by various speakers. Among those described were the 180-ton alternating-current locomotives for the New York, New Haven & Hartford R.R. for service in hauling through trains over the New York, New Haven & Hartford R.R. for service in hauling through trains over the New York Connecting R.R. They compare with the 120-ton locomotives now in service on the New Haven. They were described by E. R. Hill, of Gibbs & Hill, consulting engineers, from whose paper these notes are taken.

The completion of the New York Connecting R.R. over Hell Gate and the electrification of this line for passenger service via Sunnyside Yard into the Pennsylvania Station in New York, together with the possibility of electrification later for freight service over this line of the Long Island R.R. to Bay Ridge, has introduced some new problems. The present New Haven electrified lines are nearly level, the maximum gradient being 0.4%. In contrast to this is the profile of the New York Connecting R.R., shown in one of the illustrations.

Express trains operated between Grand Central Station and New Haven average 11 steel cars and weigh about 770 tons. Maximum trains of this character average 12 steel cars, and weigh from 850 to 900 tons. These trains must be operated between New Haven and the Pennsylvania Station over the heavier grades of the New York Connecting R.R., and therefore it is necessary to provide heavier locomotives than those now in use, or doublehead the present locomotives, as is frequently done on the heavier trains.

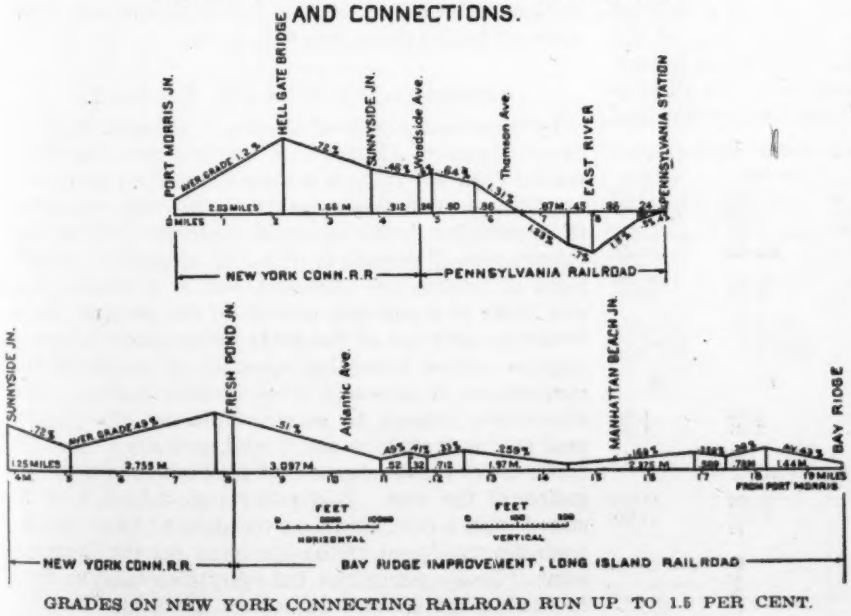


COMPARISON OF 120-TON AND 180-TON LOCOMOTIVES

Another condition limiting the New Haven's operation is the restriction imposed by the New York Central R.R. as to total weight and axle loading of locomotives using the drawbridge and viaducts on the New York Central's line into the Grand Central Station. The New York Central's conditions limit the loads on the four driving axle locomotives to 47,500 lb. per axle, and of locomotives with six driving axles to 41,000 lb. per axle. There are limitations also as to the total weight of the locomotive and the extent to which doubleheading is permitted.

The five 180-ton engines now on order represent the maximum in weight and capacity of the alternating-current direct-current type that will not exceed the New York Central structure limitations. This does not quite meet the maximum desired performance, however, for through express trains on the New York Connecting R.R. grades. The new engine will handle 12-

PROFILE OF NEW YORK CONNECTING RAILROAD AND CONNECTIONS.



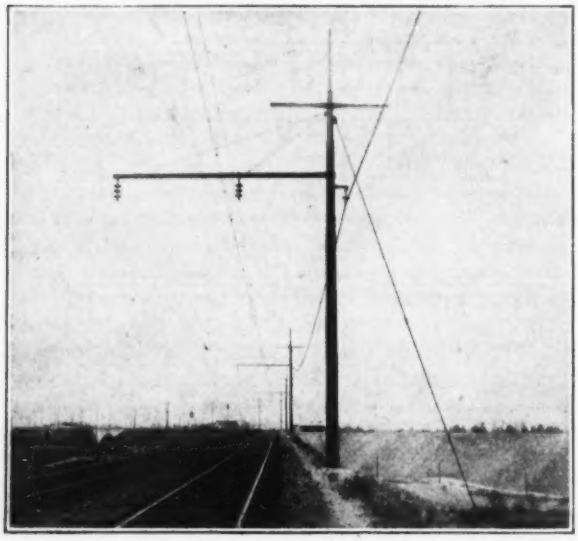
GRADES ON NEW YORK CONNECTING RAILROAD RUN UP TO 1.5 PER CENT.

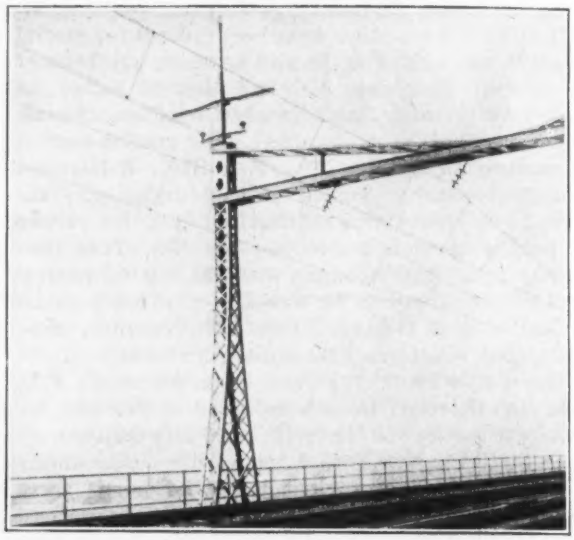
car trains on the Pennsylvania direct-current terminal grades and eastbound on the New York Connecting R.R. 0.72% grade, but will handle only 11-car trains on the westbound 1.2% New York Connecting R.R. grade. This latter grade is two miles long, and the plan is to employ electric pushers for assisting westbound trains of more than eleven cars up this grade. An alternative to this is to doublehead these engines with one of the old gearless type of locomotive.

Prior to this the latest and largest type of locomotive on the New Haven was the 2-4-4-2 engine having four driving axles and two pony axles in two trucks, each driving axle being equipped with a pair of single reduction geared motors with quill drive. The new engines are duplicates of these present engines in all essential respects, the main differences being that there are three pairs of drivers on each truck instead of two, and that pony axles are used at both ends of each truck instead of the outer ends only. Comparisons of the principal dimensions of the 120-ton and 180-ton locomotives are given in the accompanying table. In all principal respects the details of the locomotive are identical with those of the 34 freight and heavy passenger straight single-phase locomotives built in 1911 for use in freight service.

These locomotives, Mr. Hill said in conclusion, illustrate in a general way the adaptability of electric traction in meeting the constantly increasing requirements of railroad service. In this case, without modification of the general type or any of the mechanical or electrical details, and without exceeding the existing weight limitations on bridge structures, a locomotive 50% larger than those in present service has been produced simply by the addition of a driving axle and a pair of motors to each truck with adaptation of mechanical and electrical details for the mounting and control of the additional parts.

Mr. Hill illustrated his address with views of the overhead construction on the New York Connecting R.R., as well as data relating to the locomotives. Two views of typical design are here shown.





TWO TYPICAL FORMS OF OVERHEAD CONSTRUCTION ON NEW YORK CONNECTING RAILROAD

COMPARISON OF 120-TON AND 180-TON ELECTRIC LOCOMOTIVES

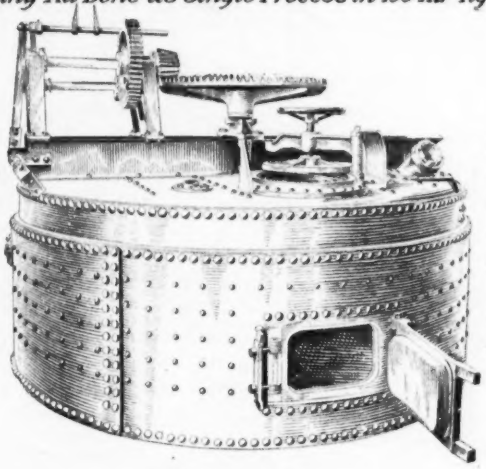
Weight, lb.	180-Ton	120-Ton
Mechanical parts	187,500	123,900
Electrical and air-brake parts	161,700	115,100
Stea.-heating equipment and miscellaneous	12,800	.....
Total	362,000	239,000
On each driving axle	41,000	45,500
On each pony axle	29,000	28,500
Rigid wheel base	14 ft. 3 in.	8 ft. 0 in
Total wheel base	59 ft. 6 in.	40 ft. 6 in
Length over all	69 ft. 0 in.	50 ft. 0 in.
Number of motors	12	8
Horsepower:		
One hour	2,550	1,770
Continuous	2,025	1,350
Maximum safe speed, m.p.h	70	55
Tractive effort	.....	.....
One hour	21,000	17,700
Continuous	14,500	12,200
Maximum safe speed	70	.....
Balanced speed with 770-ton average train:		
On level	60	.....
On 0.4% New Haven grade	42	.....
On 0.7% connecting railroad grade	35	.....
On 1.2% connecting railroad grade	28	.....

Connecticut Will Build Only War Roads

In the annual report of Charles J. Bennett, highway commissioner of Connecticut, which covers the term ending Sept. 30, 1917, it is stated that the department has become more firmly convinced that the necessities of present-day traffic on main highways require the construction of pavements of a high character. Conditions at present are abnormal, but even without the war there is a constant growth in the demand for a twelve months' use of the roads which makes it necessary to expend increasing amounts of money in the construction of improved types of road surface. The department expects to construct during the coming year only such roads as are of vital necessity to through traffic or for the development of facilities for the propagation of the war. This policy may interfere, it is stated, with a development of the state highway system from the standpoint of the tourist or for the improvement of local communities, but everything must be done to further the nation's immediate interests.

New York City has Largest and Best Garbage-Reduction Works

Plant with Capacity of 1500 Tons a Day Cuts Hand Labor to Minimum by Use of 38 Separate Conveyors; Dehydration, Degreasing, and Tankage Drying All Done as Single Process in 199 Air-Tight Reducers



The Reducer is the Vital Part of the Colwell System. Green Garbage is Spouted from Overhead Conveyor Through Top Door Shown Partly Opened. Dry Tankage is Discharged Through Side Door Onto Conveyor Leading to Screen. Grease-Bearing Solvent and Water Vapor are Piped from Reducer to Separator and Condenser.

By H. V. Schiefer
Engineer, C. O. Bartlett & Snow Co., Cleveland.

BESIDES being the largest of its kind in the world, the garbage-reduction plant recently installed to convert the millions of tons of food wastes of New York City into grease and fertilizer embodies a number of new features in design which have been the means of effecting sanitary conditions never before attained. The green garbage is not stored, so there is no possibility of decomposition at the plant. By means of a novel system of conveyors garbage is rapidly fed at will into any of the 199 reducers in which for 15 hours it is cooked, washed and steamed. The process is one of dehydration, in which there are no chemical actions after the boiling point is passed, consequently no offensive odors are created. Furthermore, the entire process of reducing a charge of green garbage to tankage is conducted in a single, continuously closed tank from which no odors can escape. Hand labor is practically eliminated by the use of 38 different conveyors for moving the garbage, tankage and waste products.

The plant is located on Fresh Kills, lower Staten Island, Borough of Richmond, New York City. There is no railroad connection. All materials used must be brought in or taken out by boats. The materials received are 1500 tons of garbage per day, necessary solvent, and coal for 3000 hp. of boilers. The materials shipped are grease, tankage and such byproducts as bottles, cans, bones and rags. To accommodate the shipping, a dock 1000 ft. long has been provided. The designers of this plant had about 57 acres of unimproved practically level land at their disposal, so the conditions were ideal for the construction of a plant for the economical and rapid handling of the garbage, the various materials required for its treatment and the final products.

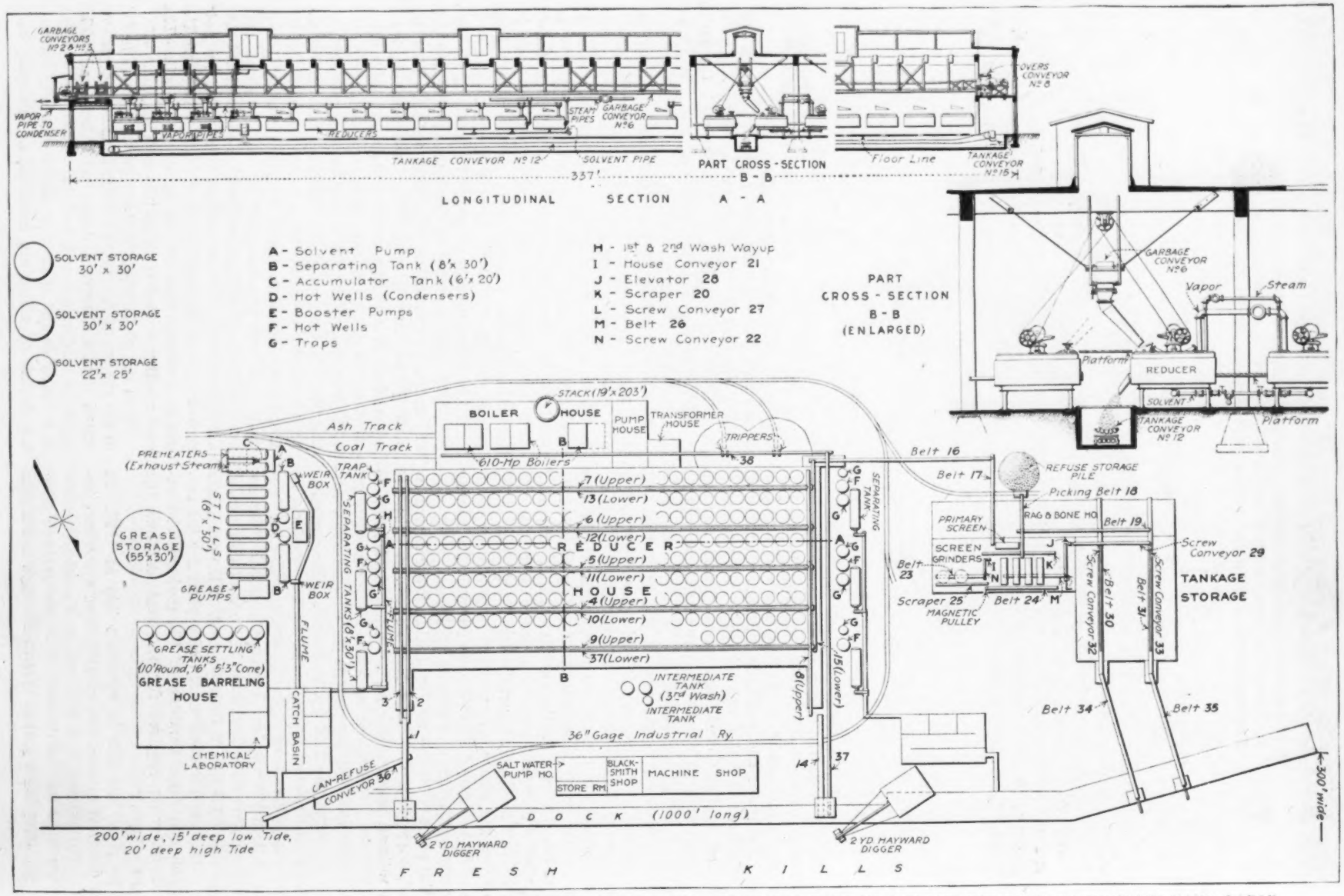
The plant was put in operation late in 1917. It was designed to meet the conditions of a contract between the Metropolitan By-Products Co. and the City of New York for the disposal of all the garbage from the city excepting a part of Queens Borough and Staten Island for a period of five years (the city reserving the privilege to buy the plant at the expiration of the contract). The nominal capacity of the plant is 1500 tons a day. It is operated in three shifts of 8 hr. each.

While in transit in 150- to 300-ton barges the garbage is covered with large waterproofed tarpaulins which are washed and spread out to dry each trip while the garbage is being unloaded.

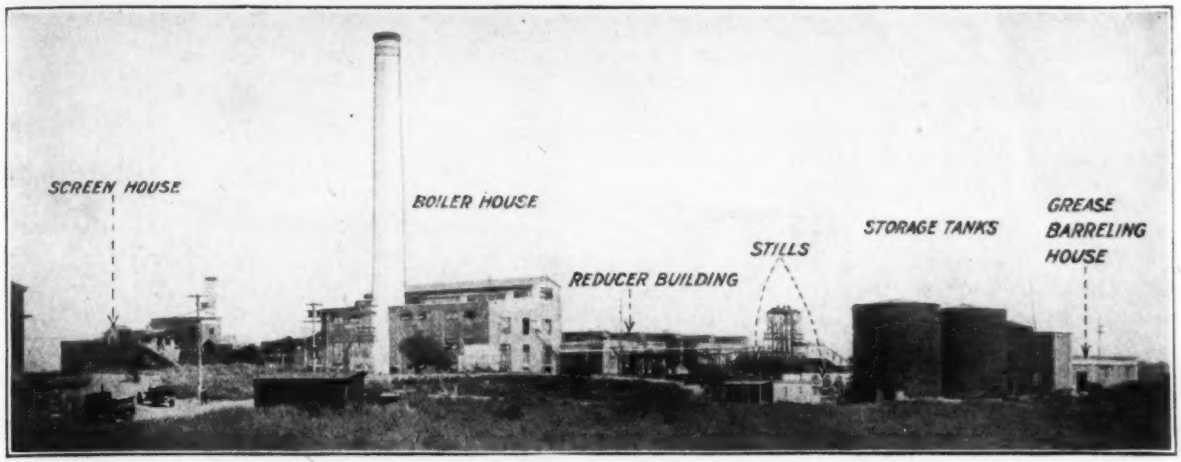
A 2-yd. clamshell bucket transfers the garbage from the barges to a large receiving hopper placed on shore and located directly over a picking or sorting conveyor. A feeder is provided under this hopper to insure an even layer of material on the conveyor which is essential to the preliminary sorting of certain materials. This feeder consists of a cast-iron box in which two intermeshing paddle wheels slowly revolve, allowing the proper amount of material to pass through.

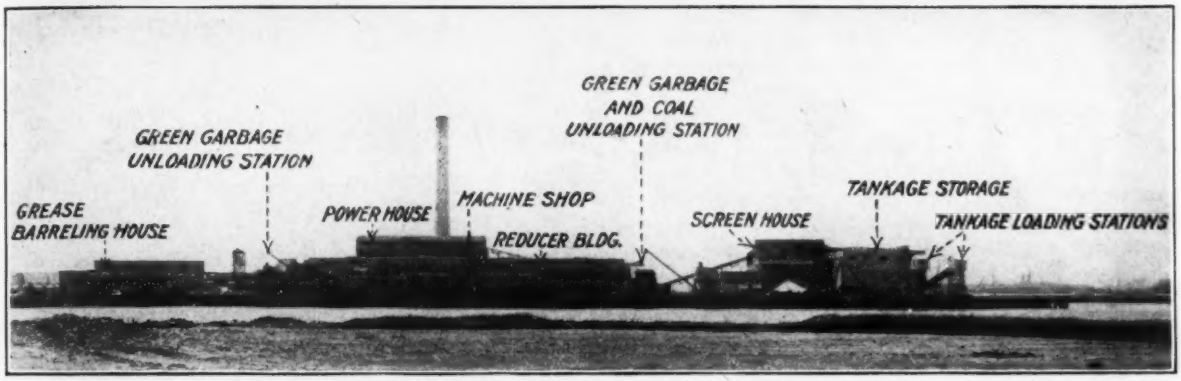
The picking conveyor consists of a series of overlapping steel pans mounted on two strands of chains that are in turn mounted on self-oiling rollers. Men are stationed on both sides of this slow-moving conveyor whose duty it is to remove (as far as possible without stirring) all glass, crockery, cans, large rags, wood and other substances that might clog the conveyors or machinery. It is here that the milk and wine bottles are recovered and placed in boxes or barrels while worthless broken crockery, sticks, etc., are thrown into a chute that leads to a dump car below. The empty cans are separated and when a boatload has accumulated they are shipped away. It is interesting to note that the tin is recovered from the cans by a bath of chlorine gas. The gas is condensed and used in the dyeing of silk. The cans are then melted and cast into sash weights.

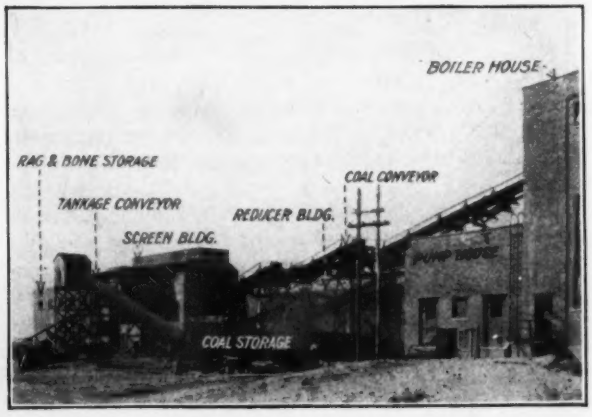
From the picking conveyor the green garbage is fed to the system of conveyors installed inside the reducer house. These conveyors, 8 in number, are made alike in so far as duplication is possible. Each one consists of a double strand of heavy drop-forged chain between the strands of which are mounted, at intervals, steel

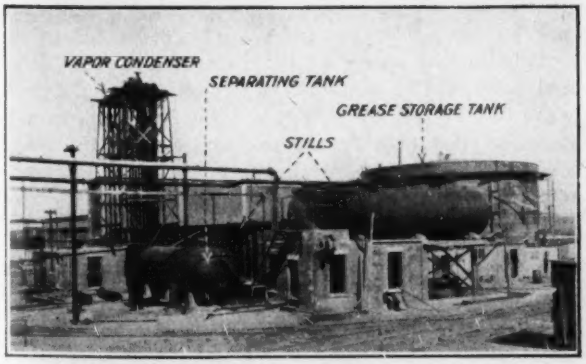


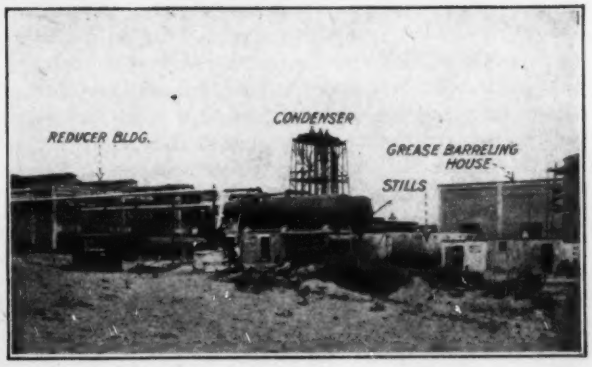
GARBAGE IS UNLOADED FROM SCOWS AND CONVERTED INTO GREASE AND FERTILIZER BASE IN A PLANT DESIGNED TO MINIMIZE HAND LABOR











THE VIEWS SHOW THE PLANT AS A WHOLE FROM THE LAND AND THE WATER SIDES AND IN DETAIL

plate flights or scrapers. These scrapers run in a watertight trough in which are located slide gates of the rack-and-pinion type. The gates are all of the same pattern, whether for feeding down to the reducers or from one conveyor to another.

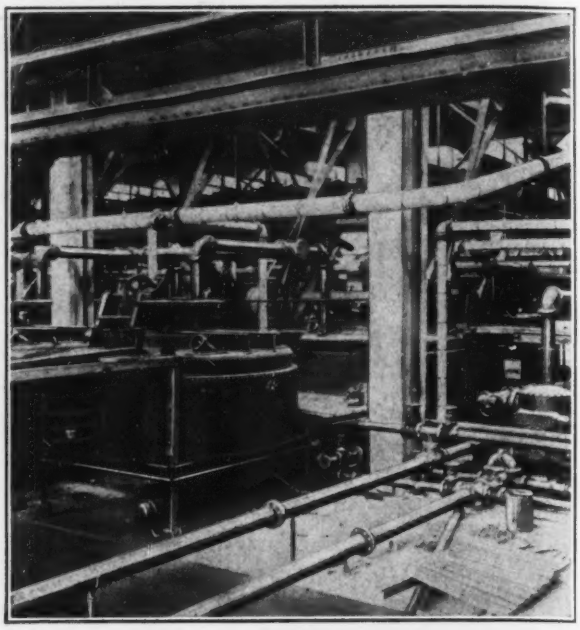
The conveyors are so arranged that by the proper manipulation of the gates the garbage can be directed to any one of the 199 reducers located under the conveyors. The conveyors are driven by electric motors—the drives being alike so that one spare part of each kind suffices for any. Conveyors 2 and 3 are in duplicate so that any mishap to either will not tie up the plant. Conveyors 8 and 9 are called the "overs" conveyors, for as their name implies they are so placed that they will catch any material that might run over the openings or be left over after filling the reducers when using conveyors 4, 5, 6 or 7.

The main or reducer building is a one-story structure of concrete with brick-filled side walls covering an area 160 x 337 ft. Space is allowed for 10 rows of reducers, 24 in a row, or 41 more than the present installation. The reducers are elevated a few feet from the floor to accommodate the necessary pipe lines, traps, etc., as well as to facilitate the discharging of the finished product onto a belt conveyor placed in a pit between two rows of reducers. There are two platforms running the length of the house. One platform is in front of two lines of reducers and gives access to all gages and sight glasses. The other platform is a little higher (just on a level with the reducer top) and gives access to the sample holes and spouts for filling in the green garbage. These platforms are made of 2 x 4-in. stuff laid flat with about ½ in. between and are the only wood in the building.

Each group of 24 reducers has its separate crew of men and its own vapor and steam lines, trap tanks, condensers and separators. Furthermore, the piping and valves are so arranged that any one reducer can be out of commission without affecting the operation of the others.

The reducer is the central feature of the disposal process known as the Cobwell system, which was designed by the C. O. Bartlett & Snow Co., Cleveland, and consists of a cylindrical steel shell whose height is about one-half the diameter. The bottom and sides of the reducers are double-jacketed and so arranged that live steam at about 100 lb. pressure can be admitted to the jacket without coming in contact with material inside the reducer. A center spindle is located on the vertical axis of the reducer, on which is mounted a pair of stirring paddles. This spindle is revolved by means of a pair of bevel gears and shafting located on the top of the tank and driven by means of a tight and loose pulley from an electric-motor-driven line shaft which serves 24 reducers. A single reducer holds about 5 tons of green garbage and is filled in from 5 to 15 minutes.

When the charging of a reducer is completed the charging door is clamped down and solvent is introduced until the mass is just covered. Steam is then turned into the steam jacket, the agitators started, and the valves to the vapor line opened. The vapors are carried to a condenser, where the solvent is separated from the water and returned to the system for further use. Sea water is used for condensing and is returned to the bay. It is interesting to note that the water vaporizes at a lower temperature when evaporated with a solvent than otherwise. Cooking is continued until the garbage is completely dehydrated and the solvent goes to the condenser free of water. During the process of dehydration more or less liquid, sometimes containing such light substances as corks, is carried over, hence it is necessary to introduce a large trap tank that can be drawn off from the bottom.



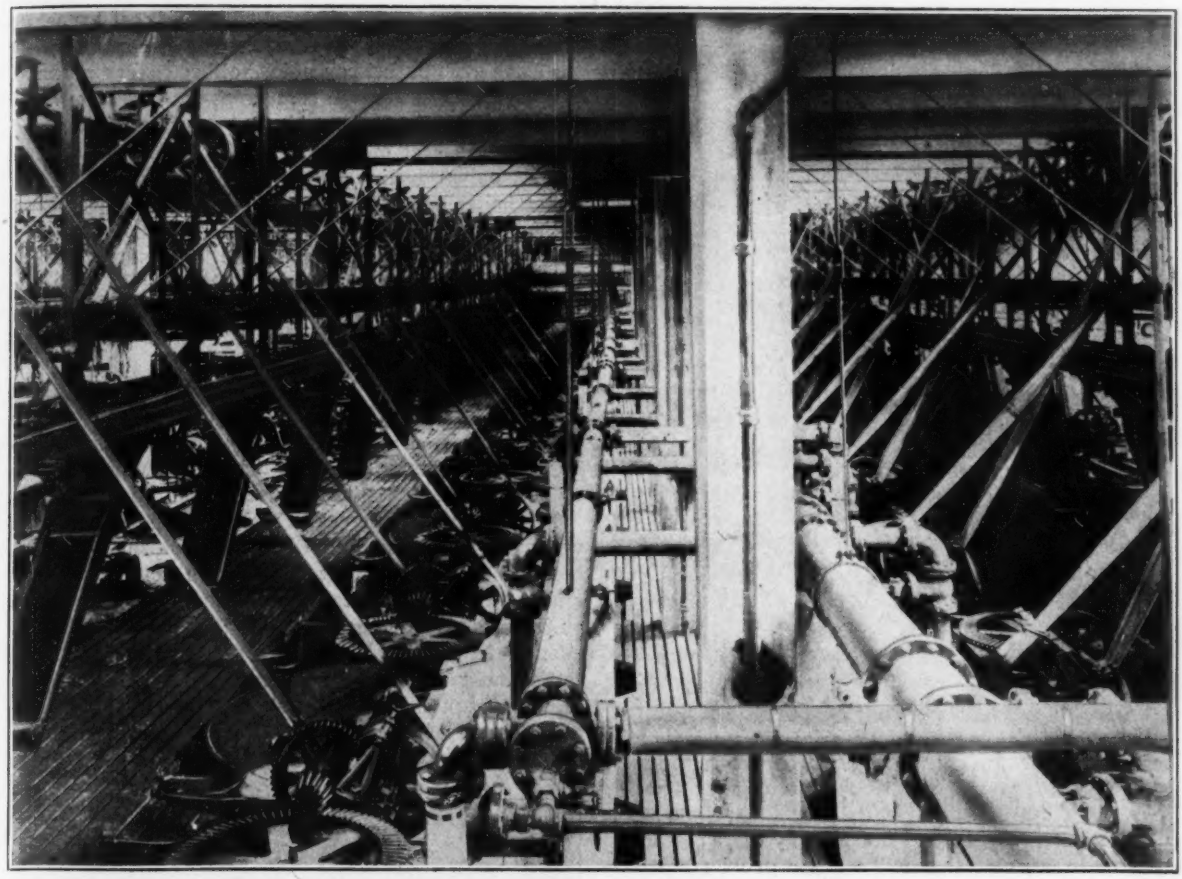
THE REDUCERS ARE NEARLY READY FOR USE

Asbestos covers yet to be placed and feeding chutes to be hung. Green garbage distributing conveyor for nearest reducer appears in upper foreground.

The dehydrating operation requires about seven hours, at the end of which time the solvent contains a large amount of grease which has been liberated from the garbage. The reducer is provided with strainers in the bottom through which the liquor containing solvent and grease is then drawn to a still or treating tank, in which the solvent is recovered by distillation. The reducer is then filled again with solvent and drawn off as before, and even a third time—the three washes requiring an average of 45, 90 and 120 min., respectively.

The separation of the grease from the solvent is all done in one still house in which are located 10 stills that can be used interchangeably. The stills consist of cylindrical steel tanks, 8 ft. in diameter and 30 ft. long, laid horizontally, in which is located a nest of small pipes for the admission of steam, the steam never coming in contact with the material to be distilled. When the grease-laden solvent is introduced it is vaporized and then condensed in a jet condenser, while the grease is left as residue and is drawn off to storage tanks.

The discharge door on the side of the reducer is then opened. The agitator is so shaped that when revolving it has a tendency to push the mass out toward the sides of the reducer, thus making it self-emptying. It requires about 15 min. to empty. The material as it leaves the reducer is of a brownish color and has an odor not at all offensive, reminding one of fresh roasted coffee.



LOOKING ALONG THE TOPS OF THE REDUCER UNITS ONE SEES THE GREEN GARBAGE CONVEYORS AND FEEDER SPOUTS AND THE BELT-DRIVEN GEARS THAT ROTATE THE STIRRING DEVICES

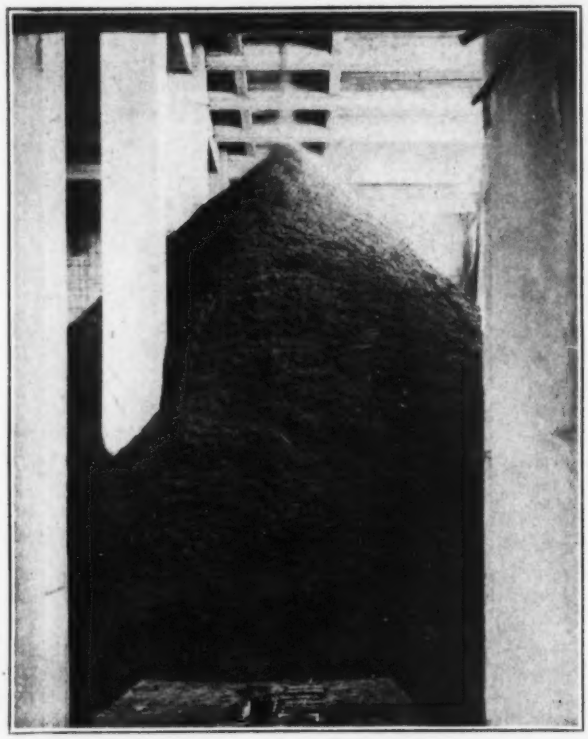
It is then perfectly dry and sterile and is usually called tankage.

The tankage is discharged from the reducers at a uniform rate and drops by gravity onto a belt conveyor for transportation to the tankage house. Although the material is warm it is not hot enough to do any damage to the belt conveyors. By a series of longitudinal, cross and inclined belt conveyors the tankage is elevated to a point about 50 ft. above the ground, where it is discharged into a large revolving screen, provided with riding rings that run on revolving trunnions. The screen is made of wire cloth with 1½-in. mesh. The tailings are discharged onto a slow-speed belt conveyor. Two men are stationed alongside this conveyor. One picks out all bones and drops them in a chute that leads to a distributing conveyor, which distributes and discharges them to the storage room below. The other picks off all the rags and tosses them to the storage bins. The material left on the belt, consisting of sticks, corncobs and miscellaneous rubbish that would not pass through the preliminary screen, is discharged to a chute that leads to a rubbish car. This material is deposited on a dump.

Corn husk, which fortunately comes only two or three months in the year, is one of the most difficult materials to put through the plant and is practically worthless as a tankage content excepting for the small amount of potash it contains. It is proposed at this plant to pick the corn husk out of the green garbage at the dock and char it in a revolving drum, thus eliminating it from the conveyors and reducers and also conserving the potash content.

The tankage that passes through the meshes of the preliminary screen is chuted to a scraper-conveyor that distributes the material to a row of four revolving screens that are duplicates of the preliminary screen excepting that the mesh is much finer. Material that passes over the ends of these final screens is discharged onto a belt conveyor provided with a magnetic head pulley. This pulley removes all particles of iron, such as hairpins and knives and forks. The amount of iron recovered is less than 0.25% of the tankage.

From this belt conveyor the material passes to a scraper-conveyor that moves the material to two dry-grinding pans. These consist of heavy cast-iron bowls 9 ft. in diameter in which the material is ground by a pair of heavy revolving cast-iron rollers whose weight is sufficient to grind anything short of steel ball bearings. The ground material is discharged onto a belt conveyor and thence to a screw conveyor that carries the material to a vertical bucket elevator. From the elevator the material chutes to a scraper conveyor which carries it back to the screens for rescreening. It will be noted that at this point there is a complete cycle so that all material passing through the preliminary screen is either screened through the final screens or removed



FINISHED TANKAGE IS DROPPED INTO STOREHOUSE

Fed from screw conveyors; removed by dropping through holes on to a belt conveyor leading to boats.

by the magnetic separator. Occasionally there are large pieces of brass, etc., that will neither grind nor separate. These are removed by hand from the dry pans or from one of the belt conveyors.

The material that passes through the final screens is finished tankage and is transferred to an 80 x 110-ft. storage house by a series of conveyors and elevators so arranged that it can be completely filled.

All tankage is shipped from the plant in boats, so there is no necessity for bagging. The tankage is dropped from the storehouse floor to two parallel belt conveyors which discharge onto inclined belt conveyors leading to swivel spouts placed on the dock. The spouts finally deliver the tankage into the holds of the boats.

A narrow-gage industrial railway connects the various departments of the plant. It is equipped with gasoline locomotives and standard contractor's dump cars. This railroad was used to good advantage during the construction of the plant and is also used for the wasting of rubbish and for the reclaiming of coal from the storage piles.

Commercial electric power has been used throughout the plant for driving machinery, conveyors and salt-water rotary pumps.

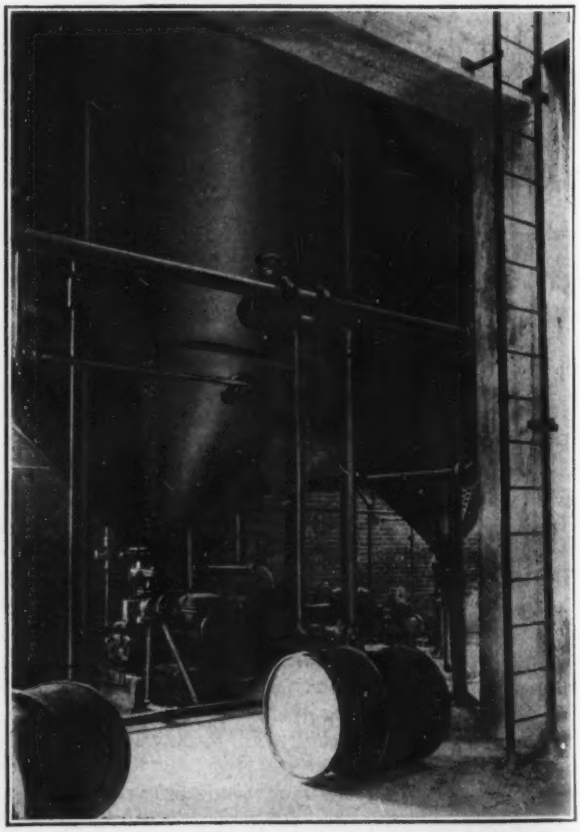
Steam is used in the reducers, stills and reciprocating pumps from a 55 x 140-ft. boiler house containing five 610-hp. water tube boilers. The stack for the boilers is of concrete, 19 ft. diameter by 203 ft. high.

Coal for the boilers is unloaded from the barges by a clamshell bucket and placed in a hopper on the dock. The coal received is run-of-mine and is fed by a double-plunger feeder into a two-roll crusher that reduces it to the proper size for the stokers. The coal hopper is placed close to a hopper for receiving garbage so that the same grab bucket can unload either coal or garbage.

From the crusher the coal drops to a belt conveyor that travels up and alongside the reducer building and deposits the coal on a conveyor at right angles that travels on an incline to a position over the bunkers in the boiler house. Two stationary trippers are placed in this belt, outside of the boiler house, so that coal may be stored on the ground. The local industrial railroad reclaims this coal and places it in the boiler house on a track provided for the purpose. A depressed track of the industrial railway leads under the stokers, so that ashes drop directly into dump cars.

The absence of railroad communication necessitated the construction of large storage containers for both solvent and finished products. This is particularly true of the grease-storage tank, which is 55 ft. in diameter by 30 ft. high, and of the grease barreling house.

In the barreling house are placed eight 10 x 23-ft. vertical steel tanks, into which the grease is pumped before barreling. These tanks have conical bottoms and the draw-off pipe for the finished grease is well up on the side. The grease is pumped into these tanks and allowed to settle. The heavy grease and impurities settle to the bottom while the pure and lighter grease is drawn off to the barrels for shipment to be used in the manufacture of glycerine, soap, candles, etc. The building is of concrete and brick and is 100 x 100 ft. It



ALL GREASE IS BARRELED FOR SHIPMENT

Finished grease is removed from a point well up on the side of the tank. The heavy grease that settles to the bottom is sent to the stills for further refining.

is placed near the dock to minimize handling of the barrels. A completely equipped chemical laboratory occupies one corner of the building. Elsewhere there is a 30 x 120-ft. machine and repair shop.

Being situated more than three miles from the nearest railroad station, it was necessary for the Metropolitan By-Products Co. to build dormitories and commissaries as well as cottages for the workmen.

I. S. Osborn, Cleveland, was consulting engineer for the Metropolitan By-Products Co. during the design and construction of the plant and John T. Fetherston was the commissioner of street cleaning of New York City.

H. H. Bighouse is chief engineer of the Cowbell Corporation and second vice president of the C. O Bartlett & Snow Company.

Catechism Suggests War-Emergency Yard Improvements

Yards and Terminals Committee of Railway Engineering Association Urges Study of Possibilities of Minor Changes to Eliminate Defects in Existing Yards

LAST week *Engineering News-Record* commended editorially the efforts of the committee on yards and terminals of the American Railway Engineering Association to focus attention on the desirability of war-emergency yard improvements. Such improvements the committee divides into two general classes—minor changes at small expense to correct defects in existing yards, and more extensive additional facilities, which may be more or less temporary, to accommodate shipping and the handling of military equipment. It is the former class to which the committee gives special attention. In its report it urges a detail examination of existing facilities, and submits a catechism as a guide in such examination.

The purpose of the catechism, states the committee, is to bring out hints as to "the improvement in detail of yards we have and the elimination of slight defects which hinder the steady operation of yard service or cause detentions which, small in themselves, become serious in the aggregate."

Following is the substance of a circular sent out by the committee last October:

There are certain general principles governing the design of yards, yet each yard constitutes a separate problem with its local conditions of design and operation. Improvement in detail of any one yard, therefore, will be governed largely by these conditions rather than by general principles. For this reason it is suggested that each railway should consider the improvement in detail of its individual yards.

Reconstruction and alteration of yards on a large scale is impracticable at this time on account of press of more important business, the lack of money and the shortage of material and men, to say nothing of the undesirability of assigning engines and cars to work of this kind. Of greater importance at the present time is the improvement in detail of the yards we have, and the elimination of minor defects or features which hinder the steady operation of yard service or cause detentions which, small in themselves, become serious in the aggregate.

Small Investigating Committees Urged

Real improvement of this kind can be made only by a careful study of the yard and its operation. This should include consultation, not only with the local officials, but also with the yardmen and switchmen, as they have the details of the service at their finger ends and know where and what are the weak points. It is the thought of the committee that great good could be effected on many railways by the appointment of a small committee, detached from all other duties, to go over the line and make a detailed study of the operation of the larger terminal and division yards for the purpose of determining instances where minor or simple changes or additions will facilitate or cheapen operations to an appreciable extent. The committee should preferably be composed of a representative of the engineering department who has had experience in the designing of yards and manifested a thorough conception of yard requirements, and a practical yard man, a yardmaster or perhaps a yard conductor who has given evidence of a live understanding of yard operations. Such men are to be found on every railway.

This committee should be instructed to approach every case with an absolutely open mind. Its recommendations should be made with the expectation that the improvements recommended will be made promptly.

Knowledge of improvements of this kind in one yard may be helpful and suggestive in the improvement of other yards and on other railways, and it is desirable that information as to such detail improvements should be presented to the yards and terminals committee. Information that will be of common interest will be embodied in the report of this committee to the association.

A certain classification of yards, according to their purpose, should be recognized.

Ocean Terminals

Apart from the general yard problem, ocean terminals constitute a special class and, under present conditions, present an emergency problem that must be met in a large way, requiring the construction of extensive additional facilities that may be more or less of a temporary nature.

Extra detentions may be caused by lack of vessels to receive the freight. This results in holding up the equipment, with consequent congestion of the terminal tracks. Much can be done in such cases by the provision of warehouses and storage facilities for foreign shipments held awaiting vessels, thus releasing cars and clearing the terminal tracks.

An entirely different and unusual situation is involved in the handling of military equipment. At shipping ports this traffic may be too great to be handled

in existing yards, and it may be desirable to establish separate yards where men, stock, supplies and munitions can be unloaded and held awaiting shipment. The layout of such yards requires special consideration, and it will be of interest to secure information as to what has actually been done in this direction.

Because responses to this circular were meager, and such companies as replied (this being before the Government took over the operation of the railroads) deemed the investigation not feasible at this time, the committee prepared the catechism, which follows.

Catechism of Yard Design and Operation

The principle of good yard design comprises three fundamental requirements, which are:

1. To get train into yard and clear the main line.
2. To classify the cars in the yard, which includes all intrayard movement of cars and engines.
3. To get the train out on the main track and clear the yard.

With these principles in mind, the following suggestions arise in the form of direct questions:

1. Can you extend your yard lead or construct one adjacent to the main track of sufficient length to hold a maximum train, so that an arriving train can quickly clear the main track before entering the yard and a departing train may quickly clear the yard before going out on the main track? If trains arrive or depart at close intervals, can a second lead track be constructed? These lead tracks are sometimes called receiving or departure tracks.

2. Are your connections between (a) main tracks, (b) lead tracks, (c) drill tracks (or tracks on which switch engines operate), (d) yard tracks so arranged that trains may enter and leave the yard with a minimum of interference with switching movement?

3. Are your yards so arranged and have you sufficient running tracks so that you can take a transfer from one end of the yard to the other without interfering with the usual switching? Could the efficiency and capacity of the yard be increased by the enforced holding open of a track (otherwise used for holding cars) as a running track?

4. Are your crossovers so arranged as to give the least interference with switching and the greatest elasticity of movement, or can additional crossovers be put in to secure these results Where the number of tracks in the classification yard is fixed and where the number of classifications has increased, can connecting crossovers be so located between these classification tracks as to reduce the number of movements for the required classification?

5. If your receiving or departure tracks are too short, can you lengthen one track in each yard in order to take care of the maximum train?

6. Are your caboose tracks so located and have they such connections at each end that cabooses may be handled with the least amount of switching service?

7. Can you take the engine off your train and get it to the roundhouse and also get it from the roundhouse to an outbound train, without materially interfering with switching?

8. Can you facilitate handling road engines by providing a "tie-up," "parking" or "engine-storage" track near the engine terminal?

9. Can your yard engines clean fires and take coal, sand and water without delay? Do you change your switching crew where the engine works, or do you send the engine to "tie-up" track for change?

10. Are the trackmen given opportunity to repair busy tracks? Are you having yard derailments or delays due to bad tracks, particularly at curves, switches and frogs?

11. Can you quicken movement of trains through the throats of the yard by putting on switch tenders at these points during the busiest part of the day?

12. Is the present assignment of tracks in the yard for the various operations the proper one?

13. Can you in any case improve the yard movement by reversing the movement of traffic?

14. Can you facilitate switching by making inexpensive changes in the grade in the yard at any point? If you are operating a hump, can you change the grades of the hump and facilitate switching?

15. Are you using the cut-list system in hump yards to avoid confusion in classification and fix responsibility for damage while handling cars?

16. Can you improve switching conditions after dark by installing lights?

17. Are you handling any cars through the yard with more movements than are absolutely necessary?

18. Could you facilitate weighing and lessen interference with other switching by rearrangement of existing connections or by the addition of other connections to the scale track?

19. Are your bad-order and repair tracks so located as to require the least amount of engine service?

20. Can you lessen the cost of icing cars by changing the track layout?

21. Are your car inspectors properly organized, and so located and equipped that they do not delay switching or departure of trains?

22. Can some terminal delays be avoided by the installation of compressed-air lines to charge the brake equipment of trains and avoid the delay of pumping air on the train after the engine is coupled on?

23. Are your outgoing trains delayed "waiting for orders"?

24. Is your yard or road service hampered due to lack of proper telephone facilities or other means of communication?

25. Is the time of switching crews wasted by faulty handling of waybills?

The section of the committee's report from which the foregoing was taken has been reprinted in pamphlet form, and can be obtained from E. H. Fritch, secretary, American Railway Engineering Association, 910 Michigan Avenue, Chicago.

Oregon Purchases a Paving Plant

The paving plant owned by the Oregon Independent Paving Co., Portland, Ore., was recently purchased from the company by the State Highway Commission of Oregon for a price said to be $13,500. When in possession of this plant the commission intends to handle much of its own paving and maintenance work during the season of 1918, although to what extent it will consider itself a competitor of road contractors has not yet been made public.

Multiple-Air-Chamber Shield for Large Tunnels

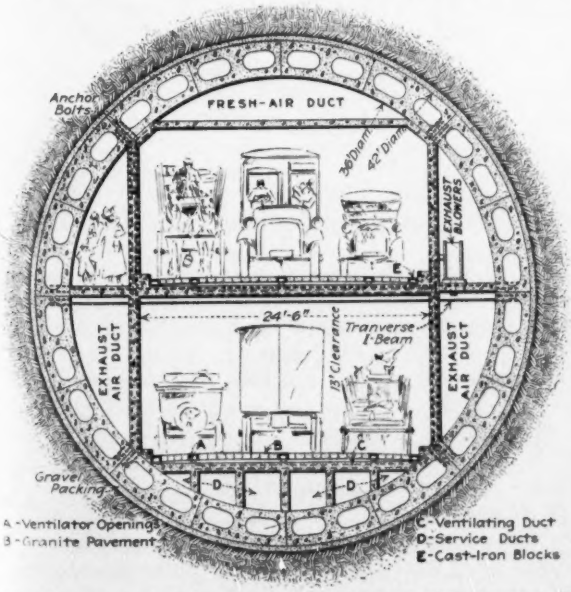
Face Divided Into Tiers of Pockets to Carry Different Air Pressures—Pneumatic Gaskets Seal Clearance Space Between Tail and Lining

By John F. O'Rourke
President and Chief Engineer, O'Rourke Engineering Construction Co., New York

THE recent joint action of the Bridge and Tunnel Commissioners of New York and New Jersey, adopting the project recommended by their consulting engineer, Gen. Geo. W. Goethals, for a shield-driven highway tunnel of 42 ft. diameter across the Hudson River at New York City, involves the employment of a shield nearly twice the diameter of any heretofore used. In connection with a proposal to construct this tunnel for the sum of $12,000,000, the writer has designed a shield of radically new type. Application has been made for a patent on this shield construction.

The shield has multiple air chambers in its forward part, each ending 3 ft. in front of the chamber immediately above it, thus enabling the excavation to be done in separate vertical faces, the escaping compressed air from each chamber entering the ground forward of the excavation in the chambers above. Means are also provided to close the space between the tail of the shield and the tunnel lining.

In considering the problem of a multiple-air-chamber shield and the behavior of the compressed air after its escape into the ground from its various levels, it is well to give attention to the manner in which escaping compressed air from pneumatic caissons makes its way through the ground to the surface. In the sinking of caisson foundations for river piers and large buildings, it has been found that the escaping air is dispersed for a considerable distance from the caissons before reaching the surface. While the greater part of the air ascends directly upward within narrow limits, in some cases of caissons for buildings it has been found escaping into cellars as much as 300 or 400 ft. distant. Experience has shown that where two caissons are being sunk in close proximity to each other the escaping air in the ground from the lower air chamber where the pressure is much higher caused no increase of pressure in the upper air chamber, showing that as the compressed air ascends it expands in proportion as the pressure is reduced in the groundwater. This is self-evident and needs no extended statement.



CROSS-SECTION OF PROPOSED DOUBLE-DECK HIGHWAY TUNNEL TO CONNECT NEW YORK AND JERSEY CITY

It is this principle of the reduction of pressure in escaping compressed air as it ascends through the ground that is at the bottom of the new plan for having superimposed air chambers in the forward part of a tunnel shield, in each of which an air pressure would be maintained suitable to the pressure in the groundwater at its front.

Face Stepped Back From Lowest Chamber

The shields heretofore used in the construction of tunnels have been designed for doing the excavation at the front of the shield from the top downward in one vertical plane, the face of which is held in place with breastboards when the material at the face will not stand up by itself; bracing and jacks hold the breastboards in place as the excavation proceeds and while the shield is being shoved forward. The shields have been divided horizontally into two or more levels when the diameter was too large for the excavation operations to be conveniently worked from the bottom, and the platforms forming the levels usually had extensible fronts operated by jacks which were shoved forward, following the excavation, to hold the breastboards during excavation and shove. The same object is attained in the new shield by numerous breast jacks arranged above one another in tiers.

In the longitudinal section of the multiple-air-chamber shield shown here, the roof and top cutting edge of the bottom air chamber extend outward about 3 ft. beyond the roof and top cutting edge of the air chamber above; the cutting edge of the second chamber has a like projection beyond that of the chamber above it, and the other chambers above recede successively in like manner.

The excavation for each shove starts simultaneously in all the air chambers, in line with the cutting edges, so the faces of the excavation are in the same planes as the cutting edges. The floors of each chamber, except the bottom one, extend forward of the excavation the length of the step. When the shove is made, the floor of each chamber slips forward so that after the shove it is the length of the shove in addition to the length of the step in front of the face of the excavation. It is to be remembered that, in the chamber below, the top face of the excavation is at the cutting edge of the floor of the chamber above. This enables the men in each chamber to look after the ground into which the cutting edge is being shoved, to pull

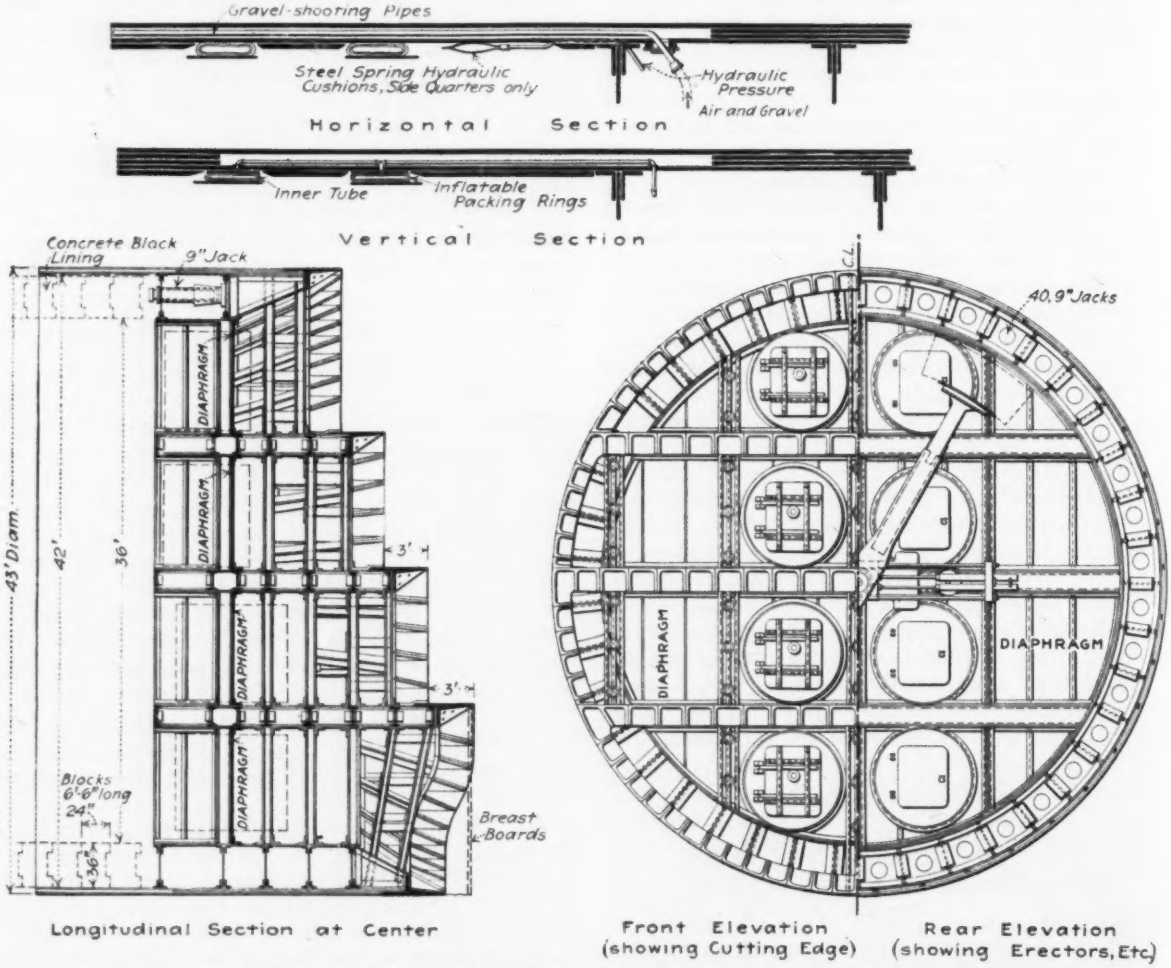
down the top breastboards and bring in small boulders as the cutting edge reaches them, or, in case a large boulder is encountered that might injure the cutting edge, stop the shove until it is either brought in or blasted. At the end of the shove the cutting edges are cut at the position where excavation is started for the next shove.

The bottom air chamber has the bottom of the shield for its floor, as in all shields, and the usual practice of keeping the bottom cutting edge a full shove back from the face of the excavation is followed, as this leaves the ground at the bottom exposed and the presence of rock or boulders is known and taken care of before the shove. In this way all of the shoving is done under the same conditions of observation and control in the multiple-air-chamber shield as in the ordinary shield whose only cutting edge is in the circumference.

At the forward end of the jack circle are located diaphragms which form the inner wall of the air chambers and contain air locks which, together with the air-tight floors and sides, make each forward level an independent and workable air chamber with an open front. Each chamber is worked with its own excavating force. This greatly expedites the excavation, which in the case of four levels has four times as many men and requires only one-fourth of the time that would be taken in a shield of one level excavated from the top downward with one-fourth the number of men at work in the shield.

In water-bearing ground each air chamber would be filled with compressed air of suitable pressure for the water in the ground in front of it near the floor, and the unbalanced pressure in each chamber would therefore be approximately that of the height of the air chamber, which, under the ordinary practice, would require a cover 1¼ times the height of the chamber. Under this rule the ground in front of the tunnel is sufficient cover for all but the top air chamber, which would require a cover above the top of the shield of 1¼ times the height of that chamber. In the case of an ordinary shield of the diameter under consideration here, the height of cover that would be required above it to retain the unbalanced air pressure would exceed 50 ft., while the multiple-air-chamber shield would require a cover on top of only 13½ feet.

That compressed air cannot enter an upper air chamber from a lower one where the pressure is higher is evident from what has already been stated in regard to the behavior of compressed air that has escaped into the ground from pneumatic caissons. In the case of the



MULTIPLE-PRESSURE SHIELD DESIGNED FOR THE PROPOSED HUDSON RIVER HIGHWAY TUNNEL

tunnel shield, the air escapes into the ground some distance forward of the air chambers above, where it immediately expands to the pressure of the groundwater through which it is ascending. As it passes in front of each successive air chamber it only has the pressure in the ground at that level, to meet which each chamber has already an equal or greater air pressure, so that there is no possibility of the air escaping from any chamber entering any upper chamber at a pressure higher than that already in that chamber. There is therefore no question of the practicability of maintaining independent air pressures within superimposed air chambers at the forward part of any shield when they project beyond one another in steps which allow the air to expand in the ground outside.

Air Leakage at Tail of Shield Serious in Large Tunnel

The next question that arises is in regard to the air pressure within the tunnel itself. This is a matter of great importance, as all the accidents that have heretofore occurred under rivers in which the earth at the front of the shield was blown away happened because of the air escaping at the tail of the shield carrying away the cover sufficient to permit the blowout at the front. Even with multiple air chambers at the front, the unbalanced air pressure in the tunnel, still equal to the total diameter, requires a radical change from the present practice in regard to closing the space between the tunnel lining and the tail of the shield. This is done in the new shield by packing. Three rings of steel plates, each about 1 in. thick, are riveted and calked to the tail and spaced apart sufficiently to form recesses; into these are set two inflatable packing rings in sections and mounted on thin metal plates. The bottom of the inflatable packing ring consists of strips of rubber, leather or the like, which project forward in the case of the tube nearest the end of the lining and backward in the case of the tube nearest the tail. These tubes would be connected to high-pressure air pipes through spaces in the skin of the shield, entering the latter inside the jack circle. The tubes would be maintained under pressure except when the shield was being shoved, during which time the pressure would be reduced to lower the friction between the tubes and the tunnel lining. The projecting lip in the case of the one nearest the end of the lining would be forced against the lining by the air pressure like the familiar flap valve, so that when the pressure in the tube was reduced there would still be a pressure contact between the lip and the lining to obstruct the escape of the compressed air. In like manner the projection from the tube near the end of the tail would be forced against the lining by pressure of water seeking to enter, so while the pressure in that tube was reduced the contact between lip and tunnel lining would prevent entrance of water.

Suitable air pressure, or even free air, in the forward parts of the shield or in the tunnel itself, can be maintained by reason of the air-tight and water-tight connection between lining and shield and by the facility with which the reversible doors of the air locks can be operated with the greater pressure either in front or behind the chamber. Thus a tunnel in part above water or ground can be driven, having compressed air in the shield chambers below water and in the tunnel itself.

The shield construction shown makes practicable much larger tunnels than heretofore. The importance of this lies in the fact that tunnels of large capacity can be built at less cost and occupy less space than the several smaller tunnels that would be required to furnish the same capacity. The larger tunnel is obviously more desirable, particularly in highway tunnels, where the capacity increases faster than the number of lines of traffic in the same direction on the same level.

The forward inflatable tube is at the center of the last ring set at the end of the shove and supports that ring in circular form. As the clearance between the tail of the shield and the tunnel lining increases from nothing at the bottom to 2 in. at the top, the varying space between the lining and the shield has to be maintained in preserving in circular form the next ring to be erected. It is proposed to accomplish this by having a metal tube properly recessed into the tail on each side of the shield, occupying the middle quadrants and maintained by water pressure. These steel tubes would be in comparatively short sections and would be distended to correspond with the curve of the lining, thereby permitting of the ready erection of the lining in exact form and of holding it in place until the next shove brings the forward inflatable ring around it.

Void Back of Shield To Be Filled by Gravel Shooting

The drawings of the shield show spaces in the skin between the jack circle and the end of the tail in which are rubber hose. Through these, gravel is blown to fill the space in the ground at the tail of the shield at the time the shield is being shoved forward. Experience has already shown that this gravel packs the space in the ground around the tunnel lining with great completeness and solidity. The gravel is ejected at a high velocity and the impact upon itself breaks the gravel into small particles with enough of its own dust to convert the broken gravel into a very dense embryo sandstone. This material, acquiring considerable hardness at once, holds the tunnel lining in place as set and maintains the surrounding ground in place without settlement or disturbance and in immediate connection with the lining, so that the ground and the lining sustain each other at once without movement of either. While the Pennsylvania R.R. tunnels were being driven across the Hudson River it was found necessary to use both braces and tie-rods to maintain the circular form of the cast-iron lining and these had to be retained in place for almost a year after the tunnel had been built, at the end of which time it was found that the ground had settled tightly around the lining with great uniformity of pressure so that the cast-iron tunnels retained their circular form unaided when the braces and tie-rods were removed to place the concrete lining.

This new method of filling with gravel the space in the ground between the lining and the walls of the excavation before either has had a chance to settle preserves the equilibrium of the ground undisturbed, and the same uniformity of pressures is obtained at once that in the case of unsupported ground required a year of settling to obtain by the restoration to the ground of its former equilibrium.

Social Reconstruction Bound To Follow Victory

British Employers Frankly Recognize Need for Democratization of Industry, Says Archbishop of York—Approves Labor Party's Platform

An interview with the Most Reverend Cosmo Gordon Lang, Archbishop of York, published in the New York "Times" Magazine of March 10, gives support—and from a most unexpected source—to the position taken by "Engineering News-Record" in respect to the social reconstruction which will inevitably follow the war. Coming from the man who is primate of the established Church of England, a member of the House of Lords, by birth, training and affiliations one of the aristocracy, this outline of prospective and inevitable changes is remarkable for its frankness and daring as well as its clarity of vision. When a spiritual head of the old order in England—the birthplace of our conceptions of individual rights and liberties—not only sees the inevitability of the greater participation by the non-capitalistic classes in the control of industry, but lends it his moral support, no one should be fearsome lest the readjustment work more damage than the total possible good. The interview is reprinted here substantially as it appears originally.

THE welding of classes which has taken place in the British Army in the trenches has been such as could never have been accomplished in any other way, and the hope for the future of Britain lies in the possible extent to which this can be carried into social reconstruction.

The first and immediate necessity is of course to conquer the Germans. But we are beginning to realize that this is only a part of the problem which the time has set before us, that, having conquered the Germans, we must conquer ourselves. The Labor party, which is developing with growing success the unification of the efforts of workers with the brain and with the hand, is working toward the condition when the industries will be controlled by the workers themselves, and this is only part of the great changes in the social and industrial scheme in Britain which are sure to come. It is quite safe to say that all our older families, all the landed aristocracy, are quite conscious of the fact that things can never be again as they were before the war; and they are most willing to face the changes that must come.

So far as I have been able to observe, there is this great difference in the effect which the war has had so far on public opinion in England and the United States: We all feel in England that the war has compelled us to reconsider in a very wide and deep way the whole character of our social system. The thought of social reconstruction is only less constantly in the minds of the people than the immediate progress of the war itself. We all feel that the war came to us at a time when we were all becoming conscious that our social system was revealing very deep defects, and our great trust is that the spirit of common fellowship which the war has called out may be transmuted after the war into an impulse toward wider social reconstruction, carried through in the same spirit of common fellowship and sacrifice.

Certainly our soldiers at the front feel this. They seem to respond readily and with enthusiasm to the prospect that they will return home to take a place in the building up of a new and better social system. Indeed, this is coming to fill a larger place in the consciousness of most people than the appeals for solidness and enthusiasm in the war. The ready response to these latter we take for granted, as is our national way; the forefront of our minds is full of thoughts of what is to be done at home after the war is won.

I do not seem to observe this so much in the United States, so far as I have been able to learn of conditions here. It is very natural that your immense material resources should operate to insure high wages and ample employment. But I should not be surprised if in the course of a generation or so the people of the United States may be confronted by the same economic problems which now face us in England. Our eyes are directed not only to the prospect of a lasting peace, but also to the hope of a better social system which shall result from the continuing moral influence of united effort in the war.

The main impulse for this reshaping of our society will come from the great labor organizations, but nothing is more striking than the way in which the employers frankly recognize that they must be prepared to look at the new situation in a new spirit. The first definite proposal for economic reconstruction with the authority of the Government was the setting up of joint industrial councils for all the great industries, in which representatives of the workmen will meet representatives of the employers on equal terms for the settlement of all matters connected with the conduct of the industry. This plan so far has been carried out with real good will by the best of the employers and the best of the leaders of labor.

The Labor party's manifesto naturally and rightly points out the full demands of labor in a reasonable way, and represents the tendency toward which the movement will be directed. But beyond question there are in the full program many features which could not be carried out at once without dislocating industry. The real problem, however, is that employers must recognize the necessity of giving to the workmen a larger share of the product of the industry and a greater share of control of the management of the industry.

On the other hand, the employers feel, and the best of the workmen feel, that this must be balanced by a greater output of productive energy on the part of the workers. So far as I can judge, the output per man seems to be greater in most industries in America than it is in England. We have been hampered by trade

union regulations which have been made—in all good faith, to be sure—in the attempt to obtain a high average wage, but which the best workmen feel to be based on an imperfect knowledge of the basic facts of economics.

So the alteration of these regulations is also a part of the problem; there must be a larger share for labor both in the reward and in the management of industry, and there must be larger productivity.

State socialism has been very much discredited in the Labor party, but a very large group feels that there must be a greater control, and ultimately full control, of each industry by the workers in that industry; an increasing share of control by the workers with brain and hand. And that this movement is sure to go far is recognized by those who in the past have been the governing classes. It remains to be seen how far this increasing democratization of industry and these alterations in our national life will be directed and influenced by the traditions and the spirit of those who in the past have controlled the affairs of the nation.

But a very great deal depends on the decisiveness of our victory in the war. If, after all the sacrifices that have been made, the result is inconclusive, it will have a profoundly depressing effect upon the spirit in which all classes approach the future. Such an outcome of the war would render more likely the outbreak of bitterness, of party spirit, of class antagonism. A patched-up peace would leave everybody sore and querulous, disappointed, and with a strong tendency to meet the new conditions in the spirit of antagonism in which too often they met the old.

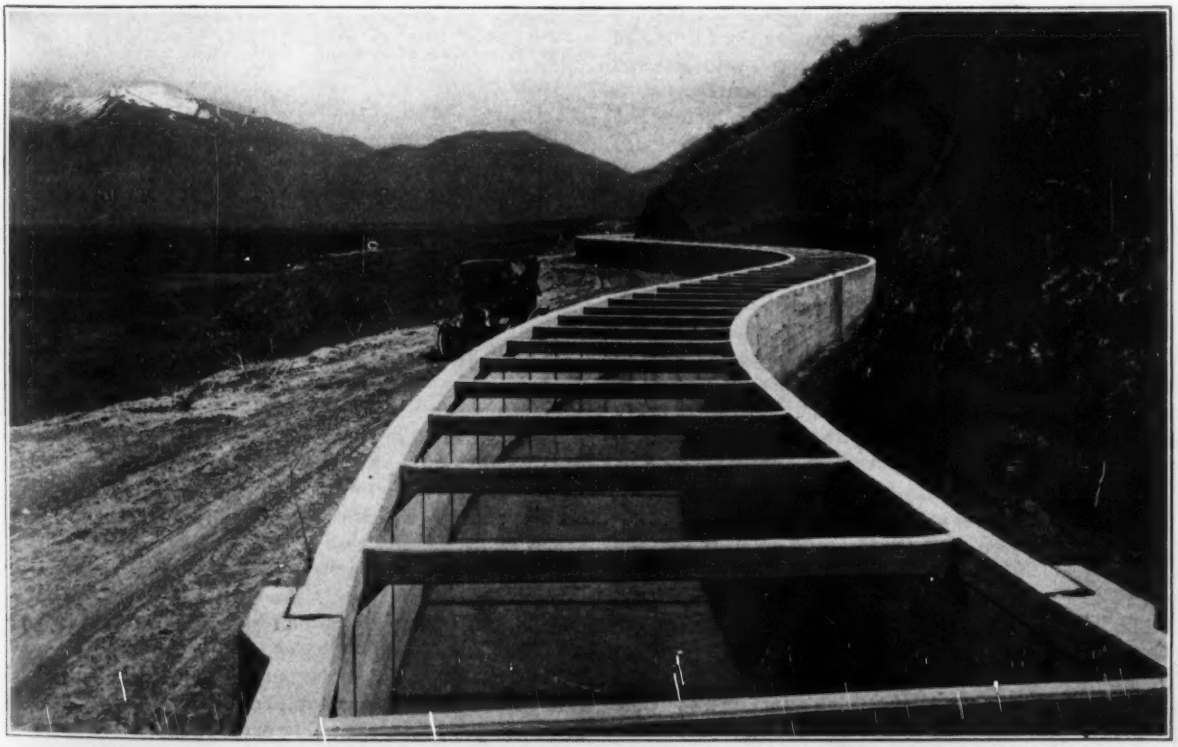
Reinforced-Concrete Flumes Poured in 100-Foot Lengths

Hub-and-Spigot Expansion Joints in Six Irrigation Conduits Totaling a Mile in Length Have Done Their Work for Two Years

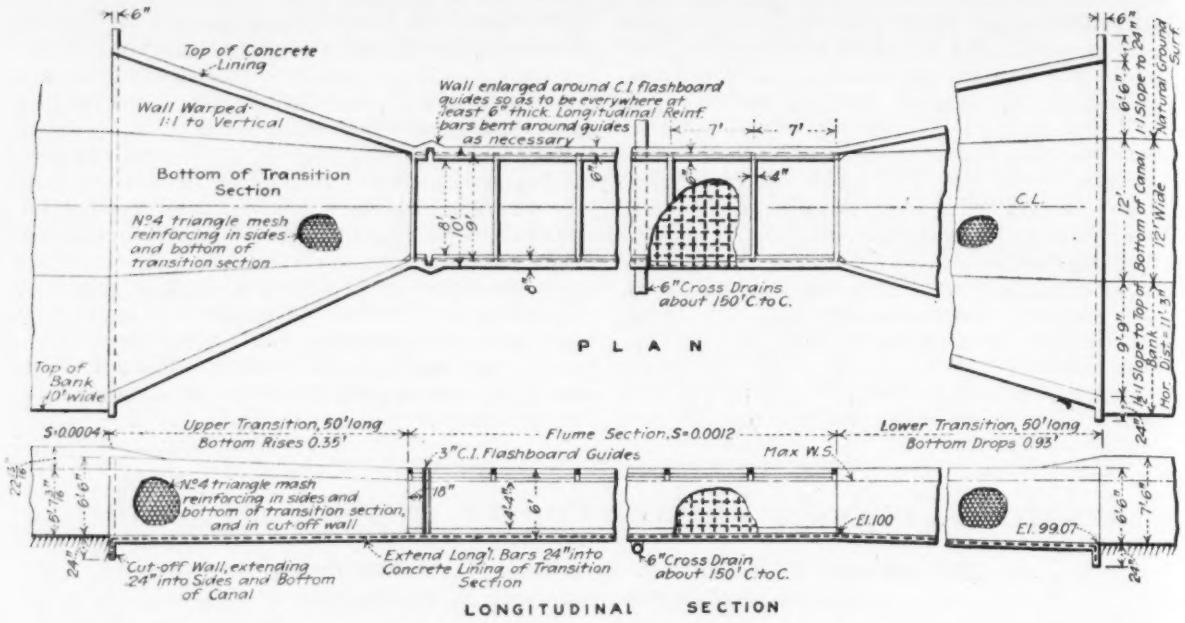
WHERE the high-line canal of the Stromberry Valley project of the U. S. Reclamation Service, Utah, skirts steep hillsides and mountain slopes of 50 to 75% grade and passes through alternate layers of sand, gravel, and fine clayey and sandy silt, the earth canal gives way to reinforced-concrete flumes, built on an excavated bench wide enough to accommodate a 12-ft. roadway also. There are six of these flumes, totaling 5184 ft., in the 17 miles of the canal.

The canal and flumes are designed to carry 302 cu.ft. of water per second, allowing a value of $n = 0.0012$ for the flume. Hub-and-spigot expansion joints filled with "sarco" or mineral rubber are placed in the flume at 100-ft. intervals. After two years of service and considerable movement at the joints, particularly during cold weather, very few cracks have appeared in the flume. At the entrance to each flume, stop-plank grooves were built into the sidewalls to provide for shutting off the flow.

After the flume subgrade had been properly prepared, the center line stakes were reset at distances of about 6 ft. The outside forms, which were made up in sec-



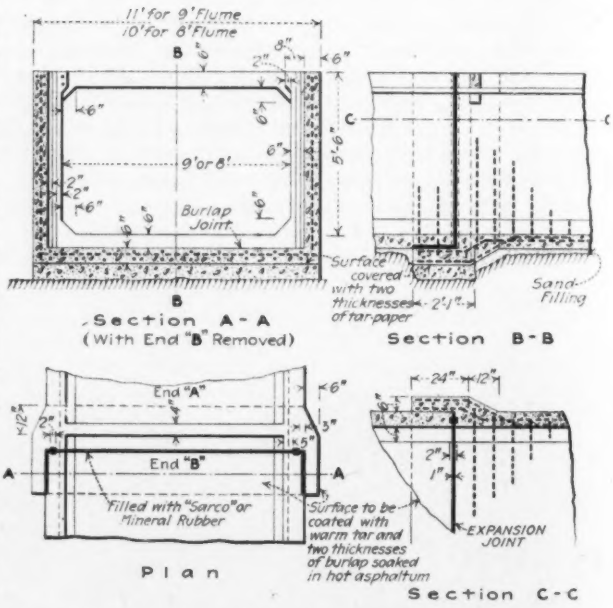
A BENCH WAS EXCAVATED ON THE HILLSIDE TO GIVE SPACE FOR THE FLUME AND A 12-FT. ROADWAY


Top of Concrete Lining
Wall Warped 1:1 to Vertical
Wall enlarged around C.I. flashboard guides so as to be everywhere at least 6" thick. Longitudinal Reinf. bars bent around guides as necessary
Bottom of Transition Section
No 4 triangle mesh reinforcing in sides and bottom of transition section
6" Cross Drains about 150' C to C.
PLAN
Top of Bank 10' wide
Natural Ground Surf.
6'6" 1:1 Slope to 24'
12' Bottom of Canal
12' Wide
9'9" 4:1 Slope to Top of Bank
Hor. Dist = 11' 3"
C.L.
S=0.0004
Upper Transition, 50' long Bottom Rises 0.35'
Flume Section, S=0.0012
Lower Transition, 50' long Bottom Drops 0.93'
3" C.I. Flashboard Guides
Max W.S.
El. 100
El. 99.07
No 4 triangle mesh reinforcing in sides and bottom of transition section, and in cut-off wall
Cut-off Wall, extending 24" into Sides and Bottom of Canal
Extend Long'l. Bars 24" into Concrete Lining of Transition Section
6" Cross Drain about 150' C to C.
LONGITUDINAL SECTION

tions or panels each from 12 to 14 ft. in length, were placed directly upon the subgrade. The reinforcing steel was then put in position and the inside forms were placed by being suspended from timbers running across the top of the outside forms. The construction forces were required to pour all of the concrete in a 100-ft. section of flume between expansion joints in one continuous operation. The concrete in the lower corners and in about 2 ft. of the side and bottom was poured first for the entire length of the section. The bottom was then completed and lastly the sides and struts were poured. Alternate sections of the flume were formed and poured as it was necessary to remove the forms and allow the bell part of the expansion joint to set and dry out somewhat before treating the surface with asphaltum preparatory to forming and pouring the spigot part of the joint on the next section.

The lagging used on the forms was what is commercially known as shiplap, and as the placing of the concrete was very carefully done the surface of the sides was left very smooth. The bottom of the flume and the top edge of the sides and struts were carefully finished with a steel trowel. No wires or bolts were allowed to extend through the concrete sides or bottom of the flume and no connection could be made between the inside and outside forms. The forms were removed from the completed sections 48 hours after pouring had been completed. The sides and bottom were then covered with burlap to protect them from the heat of the sun and the burlap was kept damp for two weeks.

The gravel and sand used was screened and carefully graded. The proportions of the mixture forming the concrete was 1 : 1.8 : 3.7. Each batch was mixed 15 seconds dry and 90 seconds after introduction of the water. The time was counted from the placing of the last materials in the mixer until the first concrete from the batch was dumped. Six sacks of cement were used per yard of concrete. All finishing mortar was made up of three parts of sand to one of cement.



REINFORCED-CONCRETE FLUMES WERE BUILT WHERE THE CANAL LINE SKIRTED STEEP HILLSIDES

At a number of places along the flume the struts were replaced with a reinforced-concrete slab for the purpose of preventing the loose material from the steep mountainside from running into the flume. This greatly lessened the amount of material excavated, as the slopes of the cut at these points were left much steeper than they would ordinarily stand at after being exposed to the wind and weather, since after the flume had been covered the caving of the material could not cause any trouble.

The flumes were built by contract during the construction season of 1915 at a total cost to the United States of $12.17 per lin.ft. excluding excavation.

Cost of Housing Soldiers at Cantonments Averages $214.92

General Littell Presents Detailed Figures on Both Classes of Camp—National Guard Camps Cost $87.60 Per Capita

SOME interesting cost data on cantonment construction were revealed at a recent session of the House subcommittee on urgent deficiencies.

Brigadier General I. W. Littell testified that the per capita cost of various cantonments (based upon the number of men who have been assigned to each), was as follows:

American Lake, Camp Lewis, $158.38; Annapolis Junction, Camp Meade, $254.16; Atlanta, Ga., Camp Gordon, $188.03; Ayer, Mass., Camp Devens, $275.64; Battle Creek, Mich., Camp Custer, $255.54; Chillicothe, Ohio, Camp Sherman, $250.57; Columbia, S. C., Camp Jackson, $205.45; Des Moines, Iowa, Camp Dodge, $168.17; Fort Riley, Kan., Camp Funston, $211.71; Fort Sam Houston, Tex., Camp Travers, $162.43; Little Rock, Ark., Camp Pike, $212.89; Louisville, Ky., Camp Taylor, $160.25; Petersburg, Va., Camp Lee, $248.28; Rockford, Ill., Camp Grant, $206.18; Wrightstown, N. J., Camp Dix, $232.95; Yaphank, L. I., Camp Upton, $272.

The average cost is $214.92. The total costs are shown in the accompanying tables.

General Littell testified that the average percentage of the cost represented by the contractors' fee on the National Army cantonments was 2.84%. On the National Guard camps the percentage was 6.88 and on the embarkation camps 3.52. The highest percentage received at any National Army cantonments was 3.67%, and the lowest 2.2%. The highest percentage at any National Guard camp was 7 and the lowest was 6.38.

TOTAL ESTIMATED COST FOR CONSTRUCTION OF NATIONAL ARMY CANTONMENTS

Location of National Army Camps	Name of Camp	Date of Estimate	Barracks and Quarters	Supplies, Services, and Transportation	Roads, Walks, Wharves, and Drainage	Shooting Galleries and Ranges	Construction and Repair of Hospitals	Military Post Exchange	Total	Number of Personnel	Cost per Capita
American Lake, Wash.	Lewis	Dec. 10	$3,497,968	$2,501,064	$338,096	$51,107	$592,000	$27,000	$7,007,235	44,685	$158.38
Annapolis Junction, Md.	Meade	Dec. 31	5,033,510	4,151,110	865,121	50,000	370,259	30,000	10,500,000	41,309	254.16
Atlanta, Ga.	Gordon	Dec. 20	4,654,472	2,096,990	295,706	54,000	444,664	27,170	7,483,002	39,796	188.03
Ayer, Mass.	Devens	Nov. 12	4,537,431	3,731,718	680,315	54,604	692,899	30,178	9,727,145	35,288	275.64
Battle Creek, Mich.	Custer	Dec. 1	3,511,475	3,671,180	673,672	51,704	764,969	27,000	8,700,000	34,045	255.54
Chillicothe, Ohio	Sherman	Dec. 1	4,920,300	3,339,795	506,009	(1)	795,646	58,325	9,620,075	38,393	250.57
Columbia, S. C.	Jackson	Dec. 1	4,407,462	3,016,970	491,463	50,000	733,823	31,470	8,731,187	42,498	205.45
Des Moines, Iowa	Dodge	Dec. 8	3,415,469	2,391,360	518,690	50,000	413,000	27,000	6,815,519	40,526	168.17
Fort Riley, Kans.	Funston	Dec. 22	4,079,440	3,921,301	496,794	50,000	252,000	(1)	8,799,535	41,564	211.71
Fort Sam Houston, Tex.	Travis	Nov. 30	3,599,781	1,973,052	498,343	50,000	596,000	(1)	6,717,176	41,353	162.43
Little Rock, Ark.	Pike	Nov. 15	4,629,749	2,933,623	635,568	(1)	789,625	27,000	9,015,565	42,347	212.89
Louisville, Ky.	Taylor	Dec. 13	4,047,948	2,116,815	320,934	61,165	459,864	34,664	7,041,392	43,939	160.25
Petersburg, Va.	Lee	Dec. 31	6,959,280	2,956,685	414,301	35,877	891,599	42,258	11,300,000	45,512	248.28
Rockford, Ill.	Grant	Nov. 30	4,138,419	3,598,825	193,989	39,991	535,472	10,537	8,517,233	41,309	206.18
Wrightstown, N. J.	Dix	Nov. 30	4,847,630	3,390,475	343,962	175,000	839,000	27,000	9,623,067	41,309	232.95
Yaphank, Long Island	Upton	Nov. 15	5,023,161	4,276,054	763,308	23,793	988,513	53,513	11,128,341	40,913	272.00
Total National Army			71,213,495	50,067,017	8,036,271	797,241	10,159,333	453,115	140,726,473	654,786	214.92

(1) Constructed by camp quartermaster.

TOTAL ESTIMATED COST OF CONSTRUCTION, AS OF DATE GIVEN, OF NATIONAL GUARD CAMPS

Location of National Guard Camps	Name of Camp	Date of Estimate	Barracks and Quarters	Supplies, Services, and Transportation	Roads, Walks, Wharves, and Drainage	Shooting Galleries and Ranges	Construction and Repair of Hospitals	Total Cost	Number of Personnel	Cost per Capita
Augusta, Ga.	Hancock	Nov. 30	$935,563	$513,710	$130,341	$328,246	$1,347,817	$1,967,817	27,152	$72.47
Deming, N. Mex.	Cody	Dec. 15	1,288,197	681,263	151,334	38,257	380,850	2,539,900	27,152	93.54
Montgomery, Ala.	Sheridan	Dec. 22	758,902	531,260	149,411	42,758	361,282	1,843,614	27,152	67.90
Spartanburg, S. C.	Wadsworth	Dec. 9	834,769	519,691	311,000	127,046	373,966	2,166,473	27,152	79.79
Waco, Tex.	MacArthur	Dec. 15	786,834	508,099	165,426	105,400	408,516	1,974,275	27,152	72.71
Anniston, Ala.	McClellan	Dec. 14	1,027,998	1,311,548	246,321	81,674	527,911	3,195,452	27,152	117.67
Charlotte, N. C.	Greene	Nov. 30	1,426,295	907,499	228,376	79,048	555,423	3,196,641	27,152	117.73
Houston, Tex.	Logan	Dec. 5	823,000	557,108	172,050	85,000	325,900	1,963,058	27,152	72.30
Greenville, S. C.	Sevier	Dec. 1	705,322	519,361	164,944	95,200	386,613	1,871,440	27,152	68.92
Palo Alta, Cal.	Fremont	Dec. 1	959,527	522,917	90,232	81,600	334,453	1,988,729	27,152	73.24
Fort Sill, Okla.	Doniphan	Dec. 15	989,725	431,501	345,208	112,200	453,168	2,331,802	27,152	85.88
Fort Worth, Tex.	Bowie	Dec. 1	1,036,834	639,866	125,426	105,400	397,876	2,305,402	27,152	84.90
Linda Vista, Cal.	Kearney	Nov. 30	975,382	1,163,214	425,144	108,058	321,257	2,993,055	27,152	110.23
Macon, Ga.	Wheeler	Dec. 5	983,475	508,342	189,633	58,320	359,037	2,098,807	27,152	77.29
Hattiesburg, Miss.	Shelby	Dec. 1	995,685	925,385	623,265	163,500	581,990	3,289,825	30,762	106.94
Alexandria, La.	Beauregard	Dec. 1	1,089,600	756,578	341,412	74,800	386,592	2,648,982	27,152	97.56
Total National Guard			$11,617,108	$10,997,342	$3,859,523	$1,396,507	$6,504,791	$38,375,272	438,042	$87.60

Small Sewer Siphon Under Low Head Has Not Clogged

BY J. H. PUTNAM
City Engineer, Hattiesburg, Miss.

AFTER more than eight months of successful operation the writer ventures to describe an inverted sewer siphon built under his direction in Hattiesburg, Miss. The siphon has a diameter of 8 in., a length of 2860 ft., a dip of 11 ft. below the inlet end and a difference of 1 ft. in elevation between the inlet and outlet inverts. A flow of 40,000 gal. per 24 hr. from the State Normal School appears to maintain a self-cleansing velocity in the siphon. The use of the siphon avoided a choice between carrying the sewer on an expensive and unsightly trestle along a much traveled residence street fronting a park, or building two additional miles of sewer through a section which will probably not be built up for a long time to come.

The siphon consists of ordinary vitrified clay pipe, except for about 300 ft. of cast-iron pipe beneath Gordon Creek. The maximum head on the clay pipe is 9½ ft., with no allowance for friction.

To permit emptying the siphon for possible repairs and flushing it with water from conveniently located fire hydrants in case of clogging, a tee and a shear valve were placed at the creek crossing.

The joints of the clay pipe were poured with jointite and of the cast-iron pipe with lead. A number of leaks occurred in the clay pipe during the first few weeks the

conduit was in operation. These were easily stopped by first calking the joints with oakum and then surrounding them with a collar of rich cement mortar. In most instances this was done without emptying the siphon. No leaks appeared in the joints of the cast-iron pipe.

The cost of jointite delivered along the work was about 2c. per lin.ft. and the cost of laying the clay pipe about 3c. per lin.ft. The excess cost over ordinary mortar joint work was partly due to less rapid rate of pipe laying with jointite, our best day's work being 250 lin.ft. Ordinary labor was paid $1.25 and the pipe layers $1.75 a day of 9 hr. The cost of engineering and inspection is not included in the foregoing figures. No records of trenching and backfilling were kept, as the work was done by convict laborers whose time was divided between this and other work. The cast-iron pipe was laid by a gang of men from the water department in a few hours time, no records being kept.

No stoppages have occurred in the siphon since it was put in use in April, 1917.

The author hopes that the publication of these notes will bring out information in *Engineering News-Record* regarding new and instructive features in the design, construction and operation of other inverted sewer siphons, particularly those of a length fairly comparable to the one here described.

Kansas Pumps Underground Water for Irrigation

Wells Pumped Singly or in Groups—Mainly Isolated Oil-Engine Plants—Central Stations

IRRIGATION by pumping from underground water supplies is steadily increasing in Kansas, but irrigation by ditches for surface waters has been largely abandoned, as Colorado now takes most of the water formerly available. These conditions were outlined in a paper by J. B. Marcellus, Kansas state engineer of drainage and irrigation engineering, presented at the recent conference of the Idaho Society of Engineers, Idaho Irrigation Congress and several other societies at Idaho Falls, Idaho.

In the upper Arkansas River valley it is general practice to put down a battery of wells and connect them to a common suction pipe. These wells are spaced 30 to 40 ft. on a line at right angles to the underflow. In the lower end of the valley the sand seems to be coarser, and a single well may give from 300 to 1000 gal. per min. In such cases a 6-ft. pit is excavated to the water-bearing stratum and in the bottom of this a 24-in. to 36-in. perforated casing is sunk.

Centrifugal Pump Best for Work

Centrifugal pumps are considered best adapted for this work, as they have few moving parts, are simple in construction and can handle a considerable quantity of sand without injury. The single-stage pump is best for pumping heads of 50 ft. or less, and may be of the horizontal or vertical type. Where the depth to water is 20 ft. or less it is the practice to use a horizontal, single-stage, side-suction centrifugal pump, placed in the pit and belted to an engine on the surface. Where the depth to water exceeds 20 ft. a vertical centrifugal pump is used, with its impeller beneath the water and its shaft operated by a quarter-turn belt at the surface. The pump should be hung from the surface rather than attached to the well casing.

High efficiency requires a definite relation between the speed and lift. Mr. Marcellus suggests that if purchasers will demand information as to the proper speed for maximum efficiency under their conditions of lift, and will install machinery suited to their working conditions, there will be less complaint concerning low efficiencies of pumps.

Area irrigable from a well will depend upon flow of water and character of land. In Kansas a pumping plant with a capacity of 1000 gal. per min. may irrigate 100 to 200 acres. While theoretically this is 5 to 10 gal. per minute per acre, it is always necessary to have a certain amount of head to cover the land efficiently. Sandy ground will require about twice as much water as heavy ground. The ability of the irrigator may easily make 100% difference in amount of water required, and success depends largely upon the methods of preparing land and distributing water. As a rule, the larger the capacity of the plant the more good is derived from the water. Thus a flow of 1000 gal. per minute will irrigate more than twice as much land as a flow of only 500 gallons.

Cost of Pumping Plant

Internal-combustion engines are generally used for pumping, as oil is fairly cheap. Kerosene is probably more reliable for installations of 3 to 10 hp., and gasoline for smaller plants. After being started the kerosene engine does not require much attendance, but it requires more than the gasoline engine. For engines of 15 hp. or more distillate oil is found economical. Cost of pumping plant complete will vary from $60 to $100 per hp., decreasing as the size of plant increases.

One company has a central power plant which generates electricity for a number of local pumping plants, the majority of which it owns. This company has 42 wells, and last year contracted for 25 more on land recently bought. The power house is in Garden City and the transmission lines extend 30 miles into the country. Windmills pumping water for irrigation are used mainly for garden produce. It is necessary to have a reservoir to furnish enough water to irrigate with an economical head, and sometimes two or more windmills pump into the same reservoir.

Water in great quantities exists at depths of 7 to 40 ft. beneath the Arkansas River valley, which is the most profitable irrigated section. It appears to have an inexhaustible source in the Rocky Mountains, and it flows slowly from northwest to southeast. The important problem is that of bringing this supply to the surface.

Test wells must be driven to determine the character of the water-bearing sand and gravel. The coarser the material the greater will be the supply of water, and for a high yield there must be not only a thick stratum but also a fairly coarse gravel. If the first water-bearing stratum is not thick enough or coarse enough to give a high yield a second or even a third stratum may give an increased quantity. Frequently a change in location of only a few hundred feet will make the difference between a high yielding and a low yielding well.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

What Is Fair in Rate Regulation?

REVIEWED BY FREDERIC P. STEARNS

WHAT IS FAIR: A Study of Some Problems of Public Utility Regulation—By William G. Raymond, M. Am. Soc. C. E., Professor of Civil Engineering and Dean of the College of Applied Science in the State University of Iowa. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 4 x 7 in.; pp. 172. $1.

This little volume primarily sets forth in a concise and effective way the author's views of what is fair in the relationships between the public-service corporations and the people served by them. Incidentally it touches upon all parts of the problem of valuation and the regulation of rates.

The first chapter, "General Relationships," leads up from what is considered honorable dealing in purely private business to the determination of what should be considered fair dealing in the semi-public business of the public utility. The remaining four chapters deal with "Suitable Control," "Rate Control," "What is Fair Return," and "Valuation."

The principal thesis set forth in the preface is that in those matters in which the charter and franchise are silent, "public utility business should stand on the same basis as other business of equal risk and magnitude." The general line of argument is indicated by the following quotation:

"If, by lawful methods, honorable and without unfair discrimination, a public-utility corporation has under the public eye built up a business having a dependable net return of any amount or any rate upon its actual cash investment, the right to earn that return, or so much of it as may be possible during the life of the franchise, would seem to be lawfully acquired property, only to be taken from the corporation for public use by the exercise of the supreme power of government and upon proper payment of just compensation. Private dependable net earnings would be so considered; why not honorably and fairly developed earnings of the corporation?"

In other words, the author presents the view in this and many other parts of the book that if by legitimate methods earnings in excess of what would generally be called fair return on the invested capital are acquired, through the failure of the public or its representatives to reduce the rates, the corporation thereby acquires property rights in such earnings and it would not be fair to decrease them.

If this view were limited to old properties built before the era of regulation, when investors had little reason to think that there would be rate reduction except that brought about by business policy or public opinion, there would be many to agree with the view set forth; but that public-service corporations formed within this era may demand larger returns because for a time the public has permitted liberal earnings, or has been negligent about reducing rates, would seem to many to be inconsistent with fair treatment of the public.

Courts and commissions which have struggled with the problem of what is "fair value" have concluded that in the case of normal properties it cannot be predicated upon the rates or earnings of regulated properties, since a "fair value" based upon rates cannot be used to determine rates. The author appears to take issue with the courts in this matter, as he says: "In spite of the assertion of courts to the contrary, the adoption of present earning capacity as the basis for value or return base will not always result in reasoning in a circumference."

He refers frequently to "dependable earning capacity" as an element on which the value of property depends. If the statement were *future* dependable earning capacity, it would receive general acceptance, but it may be questioned if there is any such thing as future dependable earning capacity where rates are subject to regulation and the present earning capacity is not the main factor upon which rates are based.

In reading the book one cannot help feeling that it is, as stated in the preface, "the result of an honest effort, extending over some years, to determine for the author's own satisfaction just what is fair in the relationships of the public and the owners of its utilities." As a result of this effort, many views are expressed which do not follow the beaten paths, and therefore stimulate thought upon the subjects treated. The book contains much valuable material.

National Irrigation Achievements

RECLAIMING THE ARID WEST: The Story of the United States Reclamation Service—By George Wharton James. New York: Dodd, Mead and Company. Cloth; 6 x 9 in.; pp. 411; illustrated. $3.50.

A triumph of democracy is the author's conception of the great work of the United States Reclamation Service in providing water-supplies for vast areas of fruitful lands in the arid west. The triumph is all the greater because it has been achieved where private enterprise had been baffled by a desire for gain which had led it to try to separate—what in the arid west should be inseparable—life-giving water from the thirsty and otherwise barren land.

The volume is appropriately dedicated to the late J. W. Powell and F. G. Newlands, as well as to the living Walcott, Newell, Smythe, Maxwell, Davis and Lane and "all the faithful officers" who have contributed by vision, investigation, educational campaigns, legislation, engineering design and construction to the conception and consummation of the works of the Reclamation Service. The opening chapters recount the pioneer work in the field by the press, on the convention platform, and in Congress which made possible these vast engineering undertakings. The bulk of the volume describes the natural and engineering features of the several projects as well as their attractions to the settler. A number of Indian projects carried out by the Reclamation Service are briefly outlined. A concluding chapter, "A Vision of the Future," sums up achieve-

ments and prospects and pleads eloquently for guarding the revolving fund of the Reclamation Service from the spoiler.

The book is designed for wide popular reading, on the part of both possible settlers and of all who glory in our national achievements and are ready to stand for the perpetuation and full fruition of democratic institutions. The volume should be heartily welcomed by all who have had a part and still have a part, either as engineers or settlers, in the Reclamation Service projects, or who wish to inform themselves regarding some of the most notable engineering works of the day.

Timely Book on Ocean Transportation

PRINCIPLES OF OCEAN TRANSPORTATION—By Emory R. Johnson, Ph. D., Sc. D., Professor of Transportation and Commerce in the University of Pennsylvania, and Grover G. Huebner, Ph. D., Assistant Professor of Transportation and Commerce in the University of Pennsylvania. New York: D. Appleton and Co. Cloth; 6 x 9 in.; pp. 513; illustrated. $2.50.

As certain as anything can be in this present uncertain world is the prospective rapid growth of the United States merchant marine. Conditions have forced us to become the leading shipbuilding nation; just as surely in the post-war scramble for trade must we make our bid to become the leading maritime nation. With this phenomenal increase in shipping—an increase that is already upon us—must come also an increase in shipping facilities, in terminals, piers, wharves and all that pertains to harbors. This means more work for the civil engineer, and an increasing attention to a field of engineering practice which now engages too small a part of the profession. If more engineers get into this work it is hardly to be doubted that more and more of them will work over into the operating end. For such men Professors Johnson and Huebner's new book is indispensable.

The authors are well equipped for writing such a book. The senior author's similar book on railroad transportation is the accepted text, and his investigations of the traffic conditions surrounding the Panama Canal are the official authority on the subject. The junior author also has contributed many valuable papers to the science of transportation economics.

The book is directed to the student, both in and out of college. Every section is accompanied by extensive bibliographical references for further investigation if required. The development throughout is planned for the student rather than for the casual reader. It is divided into three parts. The first, entitled "The Ocean Transportation System," details the kinds of ships engaged in ocean trade, outlines the ocean routes with some specific descriptions of the half dozen large interoceanic canals, explains in detail the somewhat complicated measurement of vessels and traffic, and devotes some twenty pages to the engineering features of ocean ports and terminals. In the second part, entitled "The Ocean Transportation Service," the business end of sea traffic is taken up. This involves the organization of the ocean freight service, an explanation with many illustrations of the various papers necessary in such service, and explains the passenger, mail and express end of the ocean carriers. An important chapter is devoted to marine insurance.

Part III is devoted to the organization of the ocean carriers; that is, the business arrangement of the controlling companies, the questions of competition, rate and traffic agreements, pools, conferences, and the principles on which ocean freight and passenger rates are made. A final part deals with the very important subject of Government aid and regulation of ocean commerce and transportation. It details the various aids already given to the ocean trade by the Government, describes the conditions of Federal regulation, outlines port and terminal charges, and after a judicious statement of the different sides of the question of Government aid and control, presents the authors' conclusions as to a policy for the United States merchant marine.

To the economist, interested only in the abstract, and to the business man who has to ship overseas, such an exposition is more than interesting; it is essential to a proper conduct of their business. To the engineer who is engaged in port work, on the other hand, the book has a different value. It supplies a proper perspective; it will spread before him the many outstanding nerve lines of ocean trade which lead to the mere stone and concrete and steel of the work he is building.

Growth of Science Sketched

A SHORT HISTORY OF SCIENCE—By W. T. Sedgwick, Professor of Biology, and H. W. Tyler, Professor of Mathematics, Massachusetts Institute of Technology. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 467; illustrated. $2.50.

Such a small-scale record of the growth of science as Professors Sedgwick and Tyler have sketched out is of most directly stimulative value to the engineer because of the peculiar, intimate connection that has existed between engineering and science throughout all stages of the world's history. The history as the authors write it is in no sense a history of engineering—despite the fact that one of the authors is a member of the profession—but the relation of the growth traced out to the growth of engineering skill and methods cannot be overlooked.

Covering the entire period of historical record, beginning with the ancients of the East and descending to the present day, the authors yet manage to compress a comprehensive account of the history of science into less than five hundred pages. Their method is to tie the story to the names and records of achievement of the great luminaries who in succession guided and represented the science of their time. The discoveries and inventions of these men in themselves constitute much of scientific history. Occasional references to growth of general scientific thought or minor elements of progress that are needed to bridge the gaps between the work of different men are supplied by the authors with care and discernment.

The authors make remarkably extensive, and in a measure effective, use of the device of quoting from the writings of the great men with whom the history deals, or of their biographers or historians. A quarter or perhaps a third of the text of the book is made up of such quotations. Many of them are of essential value to the purpose of the history, and all are apt; and while many could well be dispensed with, few readers will find the addition to the bulk of the volume objectionable.

The authors' specializations—sanitary science and mathematics—are reflected in the text. The mathematical influence is particularly prominent. For the engineering reader this is an advantage. The mathemat-

ical view is not less instructive and fascinating than some other view of the world's scientific history; and the sharp definition of mathematical problems and processes contributes a better impression of orderly growth, of step-by-step expansion of scientific thought through logical study rather than through chance discovery.

A fine spirit animates every page of the book. It is clear that the authors wrote with enthusiasm. Something of the same impulse will communicate itself to the reader.

The book is written down to the level of the ordinary man, be he engineer or of other profession. It is written with good knowledge and discernment. The reader may feel measurably certain of getting an accurate weighing of the men and events that build up the history of science. Technology, it is true, is largely left in the background. Probably its relationship to scientific advance was hardly less close than that of engineering, but, at least with respect to ancient times, knowledge of the productive arts has not been recorded sufficiently for inclusion in our histories.

Utilities Magazine Suspended

Owing to war conditions the magazine issued by the Utilities Bureau has been suspended. Special numbers may perhaps be issued prior to resumption of the regular issue. Correspondence for the bureau should be addressed to M. L. Cooke, 401 W. Walnut Lane, Germantown, Penn.

French Journal Resumes Publication

La Technique Moderne, which suspended publication at the opening of the war, is now appearing again (47 Quai des Grands Augustins, Paris, France).

Trough Closet Specifications

Brief specifications for trough water closets have been adopted as a part of the Industrial Code of the New York State Industrial Commission, Albany, N. Y.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AMERICAN LUBRICANTS: From the Standpoint of the Consumer—By L. B. Lockhart, Consulting and Anayltical Chemist. Easton, Penn.: The Chemical Publishing Co. Cloth; 6 x 9 in.; pp. 225; illustrated. $2.

CHEMICAL FRENCH: An Introduction to the Study of French Chemical Literature—By Maurice L. Dolt, Ph. D., Professor of Chemistry in the North Dakota Agricultural College. Easton, Penn.: The Chemical Publishing Co. Cloth; 6 x 9 in.; pp. 398; $3.

A graduated reading course, starting with a fairly elementary vocabulary and finishing with extracts from current French chemical literature. Presupposes at least two years school instruction in French.

ELECTROLYSIS: Digest of Publication of Bureau of Standards on Electrolysis of Underground Structures Caused by the Disintegrating Action of Stray Electric Currents From Electric Railways—Prepared by Samuel S. Wyer, Consulting Engineer, Columbus, Ohio, January, 1918. Cloth-Backed Paper; 7 x 10 in.; pp. 95; illustrated. Copies of this digest may be obtained from the Bureau of Standards, Washington, D. C.

By digesting and recombining in logical order the contents of 15 "Technologic Papers" (934 pp., all told) of the Bureau of Standards, Mr. Dyer has performed a service that will be appreciated by many water-works and other public-utility officials. A few editorial foot notes and an index have been provided. References are made to the original sources by number and page of the "Paper" being drawn upon.

ELEMENTS OF WESTERN WATER LAW (REVISED)—By A. E. Chandler, Irrigation and Water Right Specialist; President of California State Water Commission; President of California Irrigation Board. San Francisco, Calif.: Technical Publishing Co. Cloth; 6 x 9 in.; pp. 158.

EXISTING LAKE LEVELS: Report of George M. Wisner, Chief Engineer of the Sanitary District of Chicago, Ill. Paper; 6 x 9 in.; pp. 3.

HIGHWAYS AND RAILWAYS OF NOVA SCOTIA: Report of Highways Division for 1917 of the Department of Public Works and Mines and of the Subsidised Railways—By Hiram Donkin, C. E., Halifax, N. S.: The Department. Paper; 7 x 10 in.; pp. 63.

THE JOHNS HOPKINS UNIVERSITY TECHNICAL SCHOOL (DEPARTMENT OF ENGINEERING): Its Organization, Operation, and the Award of State Scholarships—Report to January, 1918. Baltimore, Md.: The University. Paper; 8 x 11 in.; pp. 26; illustrated.

KENTUCKY AGRICULTURAL EXPERIMENT STATION: Sanitary Inspection of Slaughter-Houses—By J. O. LaBach and W. H. Simmons. Lexington, Ky. University of Kentucky. Paper; 6 x 9 in.; pp. 32.

NEW JERSEY PUBLIC UTILITY COMMISSION: Statistics of Public Utilities, 1916—Trenton, N. J.: The Commission. Paper; 6 x 9 in.; pp. 86.

NEW YORK PUBLIC SERVICE COMMISSION: Report for the First District for 1916. Vol. 1 (appendices in separate volume) —Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 477; illustrated.

NEW YORK STATE COMMISSIONER OF HIGHWAYS: Annual Report for 1916—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 917; illustrated.

THE PETROLEUM AND NATURAL GAS REGISTER: A Directory of the Petroleum and Natural Gas Industries in the United States, Canada and Mexico—Text includes Producers, Refiners, Compounders, Marketers, and Jobbers of Petroleum and its Products, Casinghead Gasoline Manufactures, Oil Pipe Lines, Natural Gas Producers and Distributors, Geologists. 1917-19 Edition. New York. The Oil Trade Journal. Cloth; 9 x 12 in.; pp. 547; illustrated.

QUEBEC STREAMS COMMISSION: Report for January, 1917—Quebec, Canada: The Commission. Paper; 7 x 10 in.; pp. 116; illustrated.

RELIEF FROM FLOODS. The Fundamentals of Flood Prevention, Flood Protection and the Means for Determining Proper Remedies—By John W. Alvord and Charles B. Burdick, M's Am. Soc. C. E. Chief Engineers Franklin County Conservancy District. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 165; illustrated. $2.

RETAIL PRICES 1907 TO DECEMBER, 1916—Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 427.

STATISTICS OF RAILWAYS IN THE UNITED STATES: Annual Report for 1916—Prepared by the Division of Statistics. Washington, D. C.: Interstate Commerce Commission. Paper; 9 x 12 in.; pp. 98.

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA FOR 1916: Compared with the Official Reports for 1915 and Recent Statistics of Foreign Railways—By Slason Thompson, Bureau of Railway News and Statistics, Chicago, Ill. Paper; 6 x 9 in.; pp. 124; illustrated.

SURFACE WATER-SUPPLY OF HAWAII: July 1, 1913, To June 30, 1915—Nathan C. Grover, Chief Hydraulic Engineer, G. K. Larrison, District Engineer. Prepared in coöperation with the Territory of Hawaii. Water-Supply Paper 430. Washington, D. C.: U. S. Geological Survey. Paper 6 x 9 in.; pp. 322.

SURFACE WATER-SUPPLY OF THE UNITED STATES: 1916, Part IV. St. Lawrence River Basin. Nathan C. Grover, Chief Hydraulic Engineer, W. G. Hoyt, A. H. Horton, C. C. Covert, and C. H. Pierce, District Engineers. Prepared in coöperation with the States of Minnesota, Wisconsin, New York, and Vermont. Water-Supply Paper 430. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 128; illustrated.

TELEGRAPH PRACTICE: A Study of Comparative Method—By John Lee, M. A., Postmaster of Belfast and Late Deputy Chief Inspector of Telegraph and Telephone Traffic, G. P. O., London. New York: Longmans, Green and Co. Cloth; 5 x 8 in.; pp. 100. $1.

Deals primarily with the government-owned British telegraph system but compares practice on the continent of Europe and in America. Touches also upon telephone service as an adjunct of the telegraph. Chapters on acceptance of telegrams from public, instrument delivery of telegrams, tariffs and the future of the telegraph—which the authors think will extend into broader fields.

TIDE LEVELS AND DATUM PLANES IN EASTERN CANADA: From determinations by the Tidal and Current Survey up to 1917—By W. Bell Dawson, M. Inst. C. E., Ottawa, Canada: Department of Naval Service. Paper; 7 x 10 in.; pp. 95.

U. S. RECLAMATION SERVICE: Report for 1916-17—By Arthur P. Davis, Director and Chief Engineer, and Will R. King, Chief Counsel: Washington, D. C.: The Service. Cloth; 6 x 9 in.; pp. 573.

UNIVERSITY OF TEXAS BULLETIN. Report of the Bureau of Municipal Research and Reference, 1915-1917; also Problems of University Bureaus of Municipal Research and Reference —Austin, Texas: The University. Paper; 6 x 9 in.; pp. 35; illustrated.

ZONING FOR ST. LOUIS: A Fundamental Part of the City Plan —By Harland Bartholomew, Engineer. St. Louis, Mo.: The City Plan Commission. Paper; 6 x 9 in.; pp. 30; illustrated.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Engineer Must Get Forward Look

Sir—I wish to congratulate you on the excellent editorials which have recently appeared in *Engineering News-Record*. It is revolution from an unlooked-for quarter, but it is coming in the right quarter. Engineering is an absorbing work, and the engineer has, as a rule, attended to business all too well. At least, he has attended to matters social all too little—less, I think, than the member of any other profession. And as a result the engineer is out of joint with the great sweep of things.

Tomorrow is the engineer's day, but if he is to do his full duty he must get into closer touch with the labor and socialist movements. He must get the forward look. If he is to steer, he must study the charts. If you keep on as you have started, you will have done your duty to the profession, for not only is the aim good, the execution is excellent. I thank you.

Harrisville, R. I. WILLIAM E. DIXON.

Hydraulic Jump and Backwater Curve

Sir—The article in *Engineering News-Record*, Jan. 3, p. 38, entitled "Flow Conditions in Irrigation Flumes Unstable," calls attention to a phenomenon which is not only of great theoretical interest but one which is also of more widespread practical importance than is generally recognized.

To discuss completely the phenomenon there described, in addition to the data given in the article, it would be necessary to know the neutral depth of flow; that is, the depth for which the grade of the flume would just suffice to overcome friction, or, in other words, the depth of flow which the slope of the water surface would maintain indefinitely without change throughout a long flume. This neutral depth of flow is perhaps of as great importance as the critical depth.

Whenever in a uniform channel under steady conditions the depth of flow varies at different points the change may take place in either of two entirely distinct ways. The usual method of change is by a gradual transition from one depth to another, giving a surface following one of the numerous types of backwater curves. The other method is by the *hydraulic jump*, properly so called. The latter is necessarily always an abrupt, isolated phenomenon, occurring within a very limited distance, and is a phenomenon of entirely different nature from a backwater curve.

In moving downstream with a current whose surface follows a backwater curve, the surface may be level, rising, or falling and may be concave upward or downward; and the stream may be increasing or decreasing in depth. There are perhaps a dozen types of backwater curves, the type depending upon the relative magnitude of the actual depth of flow, the neutral depth of flow, and the critical depth.

The hydraulic jump is essentially an impact phenomenon. It follows laws entirely different from, but mathematically just as exact as, those determining the backwater curves. In a jump the depth always increases. There is only one type of jump, and it occurs only under conditions which preclude the existence of a backwater curve. There seems to be prevalent a considerable mental confusion of these two distinct classes of phenomena, but for their adequate comprehension it is necessary that their relations and difference be clearly apprehended.

The so-called two alternative stages have little relation to actual hydraulic phenomena. If conditions should exist precisely right, flow might change by means of a backwater curve from the upper to the lower stage; it would be, however, extremely difficult, if not impossible, for the change to take place in the reverse direction by means of a backwater curve. In the event of the occurrence of a true hydraulic jump, the alternative stages have no significance whatever. If the initial depth in a jump corresponds to the lower alternative stage, the final depth in the jump is conspicuously less than the so-called upper alternative stage.

One of the technical reports of the Miami Conservancy District now in press is devoted to the hydraulic jump and backwater curves. Not only is the theoretical basis of these phenomena fully set forth, but there is given also a full report of an elaborate experimental investigation of the hydraulic jump to determine its adaptability for use as a means of destroying the dangerous kinetic energy of rapidly moving water.

SHERMAN M. WOODWARD,
Consulting Engineer Miami Conservancy District.
Dayton, Ohio.

Engineers Need Coöperation and Leadership

Sir—I am convinced that engineers, especially civil engineers, should immediately coöperate in an effort to bring about a better attitude of the public toward the engineer, and a higher consideration for his welfare than has prevailed in the past. The following notice was found by the writer posted in the office of the family physician: "If your family physician is now in the Army service, please indicate it. Riverside physicians protect their colleagues who are in such service by giving them one-half of all fees collected from their patients during their absence." This ought to suggest to engineers one of the ways in which an organization which is really interested in the welfare of the profession might assist in producing public respect.

We have yet to hear of any such spirit among engineers. There is apt to be a selfish grabbing of everything in sight, without regard for the future of those who are unable to protect their own interests. The engineer who returns from serving his country will generally find his practice gone and that nothing has been done to hold his position in the community. A city engineer can be discharged because he refuses to approve of grafting by the city council, but not a single effective action is ever taken, though a few editorials in your columns may be printed condemning the injustice done, and there may be discussions, more or less heated, by the membership of the engineering societies. But noth-

ing is done to vindicate the honor of the engineer, who is always left to shift for himself. There is a crying need for leaders of power who will exert themselves in behalf of the best interests of the engineering profession, and may we have soon a real worker who will rise in his might and strike for freedom. May the present war teach the engineers to fight for their rights and for proper recognition!

E. G. SHEIBLEY,
Civil and Sanitary Engineer.

Riverside, Calif.

Hydrated Lime Not Fairly Treated in Boston Sea-Water Tests

Sir—In the Feb. 7 issue of *Engineering News-Record* there is found an interesting discussion regarding the action of sea water on concrete. In the discussion is a letter from Mr. Rhett, who quotes from the proceedings of the American Society of Civil Engineers, 1917, with reference to the test conducted at the Boston Navy Yard by the Aberthaw Construction Company.

The report in question carries a statement to the effect that hydrated lime was of no benefit, but rather a detriment, to the specimen in which it was used. Three or four times a year articles appear in the technical press quoting the conclusions that were arrived at by the committee examining these specimens, and these articles always set forth the same conclusions about the specimen containing hydrated lime. For the information of all engineers interested in sea-water construction the writer desires to set forth the following pertinent facts, which possibly were not taken into consideration when judgment was passed on the specimen containing lime.

Of the 24 reinforced-concrete columns 16 in. square by 16 ft. long used in this test but one contained lime. It also happens that lime in this one specimen was not used in accordance with practice which is recommended as good construction for sea-water concrete. The specimen in question consisted of a 1:3:6 mixture with 15% of the cement by weight replaced by an equivalent weight of hydrated lime. According to all the principles of good concrete construction subjected to the action of sea water, this is too lean a mixture and even if it were considered a reliable mixture, the hydrated lime should have been made an addition and not a substitution. However, what is probably of more interest is the fact that the specimen in which hydrated lime was used was cracked during the curing period and the disintegration that has taken place since it has been subjected to the action of the sea water has occurred at the point where the crack occurred.

According to the principles brought out in the series of articles by Messrs. Wig and Ferguson in October last the disintegration in this column is exactly what one would naturally look for when the column is cracked between the points of high and low tides.

With these facts before us the writer does not understand how anyone can draw any conscientious conclusions. Reliable investigators do not draw conclusions from any one specimen in a test, but it is customary to have a sufficient number of specimens, so as to permit a safe conclusion being formed.

In the specimen under discussion, the crack automatically produced another variable, and it must be admitted that this variable is so important as to cause no conclusion to be formed, and especially when only one specimen was used.

HYDRATED LIME BUREAU,
By Norman G. Hough, Manager.

Pittsburgh, Penn.

Some Observations on Concrete in Sea Water in San Francisco Harbor

Sir—Referring to the articles on "Concrete in Sea Water" by Messrs. Wig and Ferguson in the last volume of *Engineering News-Record* and to the discussion of the same which appeared in the issue of Feb. 7, 1918, the writer wishes to record that the testing laboratory of the California State Harbor Board has been investigating along the lines suggested by Mr. Weller for the past three years and since the appearance of these articles has centered its attention on the problem of the corrosion of steel in the concrete structures of San Francisco harbor.

So far as facts or data are concerned, the conditions in San Francisco harbor are substantially in accord with the examples and data submitted by the authors of these articles. Examples of mass concrete are to be found in all stages of preservation from that which is dangerously disintegrated to that which has been unaffected by an exposure to sea water of 20 years. There are also numerous examples indicating the corrosion of steel encased in concrete and a much greater mass of evidence indicating the perfect protection of the steel of from four to ten years. The conditions affecting the concrete are so varied and the evidence so contradictory, that at present it is unwise to generalize further than to say that the most important factor in the resistance of both mass and reinforced concrete to disintegration by sea water or sea air appears to be the density and imperviousness of the concrete. The disintegration which occurs can usually be attributed to porous concrete caused by the use of improper materials or by improper workmanship.

While corroborating the facts reported by the authors and agreeing with them in the "eternal vigilance" practices suggested in the later articles, the writer takes exception to some of the theories offered by them. The inference of the second article is that the preservation of the external skin of calcium carbonate is essential to the preservation of concrete immersed in sea water. It is admitted that the carbonate is insoluble, whereas the interior hydrate is soluble in sea water. This fact was formerly held as an explanation of the superiority of pre-cast piles which were cured in air as compared with cast-in-place cylinders which were exposed to sea water immediately after concreting. A study of the actual skin on the piles disclosed the fact that owing to the dense concrete used the carbonated skin was about $\frac{1}{32}$ in. thick at the time the pile was driven, or 60 days after pouring. Furthermore on moistening the surface of the pile the calcium hydrate readily came to the surface, showing that the skin offered little resistance to the hydrate going into solution. In manufacturing these piles one side rests on a sheet of tar paper which excludes the air and prevents a carbonated skin from forming. The paper adheres to the pile, but after about a year in the water it disintegrates, exposing the surface. An examination of several thousand piles exposed

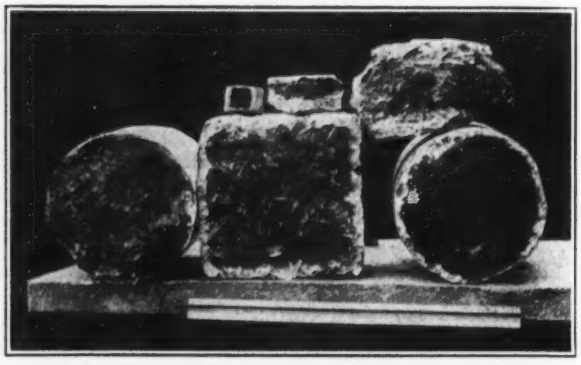
from four to seven years failed to show the slightest difference in the effect of sea water on comparing the three sides carbonated at the time of driving with the fourth, which was uncarbonated. The writer attributes the superior resistance of pre-cast concrete to the facility with which it can be manufactured and inspected and the denser concrete resulting therefrom.

As further evidence, the accompanying view of a study made by A. A. Russel, testing engineer for the harbor board, is presented. The specimens are prepared by painting a fresh break with a solution of phenolphthalein; the carbonated skin remains unchanged, while the hydrated interior is colored a deep purple. The large square specimen is a block of concrete nine years old which was removed from the face of a sea wall and prepared for the laboratory four years ago. It rests on the original face, which has been exposed to the air nine years, whereas the three side faces have been exposed four years. The carbonated skin formed readily on these latter faces and is practically of the same depth as that of the original face exposed when the concrete was green and the hydrate in the amorphous state, according to the author's theory. The two circular specimens are test cylinders about four years old. One was exposed to the air and the other remained in a tin can until two days before the photograph was taken. The specimen preserved in the can showed no carbonate skin when opened, but within two days a skin formed which failed to react, as is indicated by the white side of the specimen. The small briquette is of neat cement about four years old and the other specimens represent porous concrete taken from structures on the waterfront.

Studies made along these lines indicate that for dense concrete the skin is very thin (in one pile exposed eleven years it was ¼ in. thick), whereas for poor concretes it was very thick (in some cases 2 in. thick). In fact the reaction proved an excellent indicator of the density of the concrete. They also showed that the carbonate formed immediately and readily on exposure to air or water irrespective of the age of the concrete. In view of this it is difficult to understand wherein the protective value of this coating lies; first, because it readily allows the interior hydrate to leach through it and second, because when broken or removed the hydrate beneath readily turns to the carbonate, producing a new coating. As compared with the effect of density in the entire mass, the writer considers the preservative value of the skin of relatively small importance and its consideration a misleading hypothesis.

As an evidence of the misleading tendency of a preconceived hypothesis, the writer cites Fig. 1 of the second article. (Oct. 4, 1917, p. 642.) This is a photograph of a quay wall in the Puget Sound Navy Yard. The authors report that the top of the wall which had been cut away had softened to a depth of ½ in., whereas the uncut face showed no signs of chemical action. In order to make the case stronger they state that "there is no ice action in the vicinity." Now this particular vicinity is subjected to a surface ice action from alternate freezing and thawing which occurs daily at certain times during the winter, the temperature fluctuating from about 34° during the day to 26° F. at night. This repeated frost action under the writer's observation actually disintegrated the surface of green concrete to a depth of ½ in. and necessitated precautions in the way of canvas coverings which were spread nightly during freezing weather. With this in mind as a hypothesis, the writer would look upon the softening of the roughened top of the wall as an indication of this surface frost action.

Furthermore, it has been the practice of the Department of Yards and Docks, which designed this wall, to use what it calls a granolithic surface of from 1 to 6 in. on the face of mass concrete. This is a rich mortar which is placed simultaneously with the concrete and spaded. It would be interesting to know if the wall was



PAINTING CONCRETE SPECIMENS WITH PHENOLPHTHALEIN COLORS CARBONATED SKIN

provided with such a surface. Such a face was found in an extension of this quay wall which was removed under the writer's supervision, and he remembers that after penetrating the crust the interior was so loose that it was impossible to drill by air and difficult to drill by hand. Even when engineers do not take the precaution above noted of providing a dense surface coating, the concrete foreman will usually provide it in mass work by shoveling the mortar of the concrete against the forms and spading it well to obtain a presentable surface.

It seems to the writer that the protection which in many instances is given to the interior mass by an outer skin is explained more readily by the increased density of the skin than by the insolubility of the calcium carbonate. What is required is an interior density equivalent to that of the surface.

The third article sounded a timely warning to designers and constructors who take too many liberties with concrete as a protective coating against the corrosion of steel, particularly in sea water structures. The action of sodium chloride and other electrolytes in accelerating corrosion has long been recognized and with porous concrete or in sufficiently embedded steel the corrosion results in cracking of the concrete. The inference of the article, however, is that even in dense concrete with steel embedded 2 in. corrosion takes place, and that given sufficient time or exposure the concrete will be disintegrated. Evidence gathered thus far in San Francisco harbor is inconclusive, but in the writer's opinion it seems to indicate that there are a number of different agencies at work such as shock, excessive tensile stresses, shrinkage and temperature stresses, as well

as the rusting of the reinforcing which cause slight cracks, exposing the reinforcing to the salt air, and that after once being exposed in this way the consequent rusting is greatly accelerated and results in layer cracks and disintegration. Evidences of the disintegration due to rusting are found principally in the case of concrete-encased steel I-beam and girder construction which has been exposed from ten to twelve years, while an occasional local instance of cracking can be found in the more recent reinforced-concrete construction. The large majority of these cases, in the writer's opinion, are attributable to excessive shock and tensile stresses in the concrete. Concrete wharf structures consist for the most part of a floor rigidly connected to long slender posts or columns. They are subjected to side shocks, to settlement and to noncontinuous floor loads which produce unusual stresses because of the flexible columns and their rigid connections to the floor, stresses which are not always provided for in design. Cracks which are started by reason of these stresses are rapidly enlarged when the steel is exposed to salt air and rusts.

There are also undoubted evidences of corrosion of steel previous to the cracking of the concrete, but in every case such corrosion occurs in defective or inferior concrete. Contrasted with this is the general evidence that most of the steel has been perfectly protected for from four to ten years except where shock and loading stresses have exposed it. In one instance a test pile driven eleven years ago (the oldest in the vicinity) was cut into and steel embedded 1 in. from the surface was found in perfect condition.

Studies in the corrosion of iron and steel have demonstrated that there are several conditions under which the action is absolutely inhibited. The absence of oxygen is one such condition, immersion in certain alkaline solutions is another. It is probable that both of these conditions affect the protection of steel afforded by the concrete coating and that experiments and additional investigations will assure us of permanent protection after a certain degree of imperviousness and a certain percentage of alkalinity is obtained in the concrete.

HARRY E. SQUIRE,
San Francisco. Assistant Harbor Engineer.

Apply, But Cannot Get Work from Government

Sir—The writer wants to commend the views expressed in a letter by G. H. Palmes, printed in your issue of Feb. 21, and to add that in this part of Texas, and in Austin in particular, where no government work is going on, we have a great number of men of various trades, such as carpenters, plumbers, brick men, plasterers and painters, that have no work here, and a great many of them have "signed up," as they call it, to enter the shipbuilding line, and others have tried to enlist under the heads of their trades, but for some reason there is "nothing doing."

The writer knows of many good, able men, experts in their lines, who have made applications and have never even had a reply—and about every three or four days the papers will come out with big headlines, "Great Opportunities for Mechanics," etc.; and will go on with a lot of talk that would lead the public to think that the craftsmen were slow about coming to the aid of their country—when the fact is they cannot even get a "look in." There is something wrong some place, and I do not feel that these advertisements should be published and mislead the general public.

J. R. STANSBERRY,
Austin, Tex. General Contractor.

Inspection of Government War Materials

Sir—Perhaps one of the most unjust and unreasonable stands taken by Government officials in charge of inspection of materials for war purposes is in almost entirely ignoring the independent inspection concerns of the country, who have spent years in building up efficient organizations and who employ hundreds of thoroughly qualified inspectors only to find the Government taking over these men at attractive salaries and leaving the inspection firms to fight for existence the best way they know how. This is anything but justice to the heads of these concerns, who have given the best part of their lives to educating their men to efficiency and making them competent to fill positions as inspectors of every class of materials called for on Government orders for war supplies.

If the Government continues this method it means, unless these independent inspection companies are given some of the Government orders to inspect, that they will eventually have to sacrifice their business, which would wreck many capable men who have nothing else to depend upon, and I believe the Government should take these men into its employ and, after looking up their records as to fitness to fill responsible positions, pay them salaries at least equal to those which they were paid by the concerns they represent. I feel sure they would render the Government valuable service.

Chicago. MORGAN T. JONES.

Toothless Metal Saws

Sir—Noticing the article on p. 429 of *Engineering News-Record* of Feb. 28, I would say that toothless metal saws, are not a modern innovation. The writer was introduced to their use more than 50 years ago by David J. Stiles of Southbury, Conn., who in his day was a man of advanced ideas, and who at times was engaged in the various details of mining and mechanical engineering.

W. M. P. SHELTON,
Civil and Consulting Engineer.
Burlington, Iowa.

Trunk Highways Should Not Pass Through Towns or Villages

In many instances it is better to have the trunk roads laid out near towns rather than through them, according to the recent report of Charles M. Upham, State Highway Engineer on the highway system of Delaware. This method is not only more convenient for through traffic but less dangerous for the residents of the town, and seems to be the latest approved scheme for dealing with the increasing trunk-line traffic. An example of the excellent results of this method of design is given by the du Pont Road between Selbyville and Georgetown, which passes near but not through the towns of Frankford, Bagsboro, Millsboro, Stockley and Georgetown.

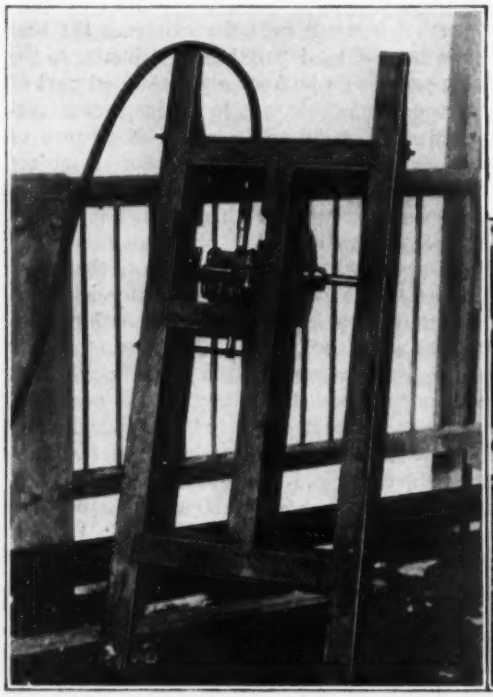
HINTS FOR THE CONTRACTOR

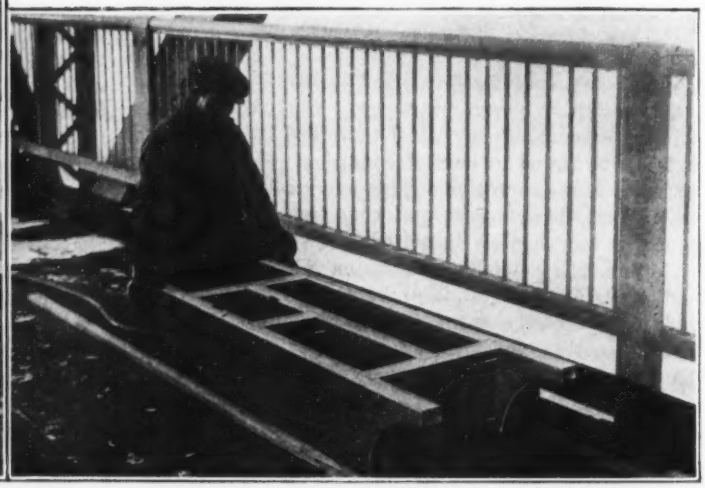
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Portable Power Saw Improvised from Pneumatic Drill

BY CHARLES J. BENNETT
State Highway Commissioner, Hartford, Conn.

FACED with the alternative of removing the guard rail and taking up the entire planking of a bridge 1800 ft. long, the Connecticut Highway Commission devised the special saw rig shown in the illustration, which cut through the first layer of flooring, making it possible to tear up the planking whose replacement was desired without disturbing the part that could still be used.





OAK FRAME, HOLDING AIR-DRIVEN CIRCULAR SAW, WAS CHAMFERED AT ONE END TO REGULATE DEPTH OF CUT

The saving in labor was considerable and, combined with the greater speed, makes the appliance more than a curiosity.

The circular saw, driven by an air drill, was mounted in an oak cradle of simple construction which was chamfered at one end so that the depth of cut could be regulated by rocking the frame—a simple matter, since the weight of the operator was sufficient. The air drill received its power from a portable gasoline compressor which was being used for some drilling and riveting on the steel work of the same bridge. In using the rig lagging was tacked to the bridge flooring in advance to serve as a guide and allow the operator to give his entire attention to the manipulation of the frame. While the photographs were not taken on the bridge where the rig was used, they illustrate the operation perfectly. A. R. Doe, superintendent of bridges, was responsible for the amplification of the suggestion for such a machine.

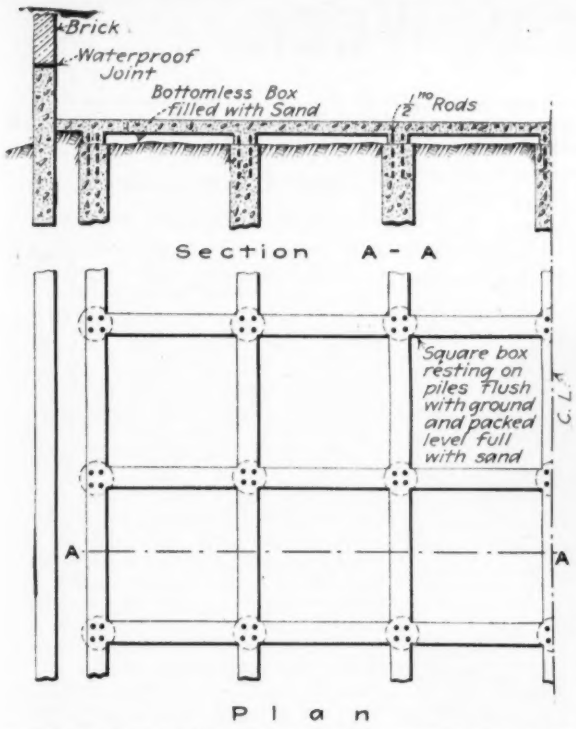
Powder Magazine Floor Slab Concrete Poured on Sand Filled Boxes

BY GENE PRATT
New York City

IN SOME of the new naval powder magazines very heavy concrete floors are being built separate from the walls in order to reduce the resistance to the force of expanding gases in the event of an explosion. A typical plan and sectional elevation of such construction is shown in the accompanying sketch. The floor is supported on reinforced-concrete piles spaced on squares of dimensions varying, with the loads to be carried, from 5 ft. for a 2000 lb. per sq.ft., to 9 ft. for a 700 lb. per sq.ft. load. On these piles are two-way beams of shallow depth reinforced according to the load. The beams carry a continuous floor slab of concrete extending over the outside beam to meet the wall, which is separated therefrom by a joint.

In construction the concrete piles are driven to a uniform elevation close to the level ground surface and ½-in. dowel rods are left protruding from the pile tops. Bottomless square boxes are placed on each group of four adjoining piles and filled level with their tops with packed sand. These boxes make a form for the shallow beams and the base for the concrete floor slab. Concrete is then poured over the entire floor area to the required floor depth.

In the particular case shown the piles are 16 in. in diameter, the boxes 12 in. apart and 6 in. deep, thus forming 6 x 12-in. beams. The slab is 6 in. deep. The outer side of the web of the outer beam is formed by a



CONCRETE FLOOR FOR POWDER MAGAZINE IS SEPARATE FROM THE WALL

continuous 6-in. board resting on edge on the outside line of the piles. Sand is packed between this board and the concrete base wall to provide bearing for the cantilever extension of the slab. The forms for the floor all remain in place after the wall is completed.

Double-Ended Flume Traveler Useful for Handling Forms

RECONSTRUCTION of a wooden trestle 70 ft. high on the South San Joaquin Irrigation District in California called for considerable handling of forms at the tops of bents. The flume design included vertical buttresses cast with the caps to carry horizontal thrust. This required more attention in form work at the top of the structure than would be the case with the ordinary simple trestle cap. To facilitate this work near the trestle top a traveler was built to operate along the top of the old flume and has been found most convenient in delivering equipment to the top of the structure and placing and removing the steel forms for the vertical buttresses.

The traveler consists of two four-wheeled trucks on which rest struts that support a beam whose length exceeds the width of the flume. This allows the beam ends to project a few feet over each side. A double-drum hand crab in the middle of the traveler, as shown in the illustration, operates two cables, one passing over a sheave supported at either end of the projecting arm. These sheaves are carried on blocks which can be slid along the beam, the sliding movement being produced by winding up a line on the short lengths of 4-in. pipe mounted on wooden trunnions on either side of the crab. With this arrangement the sheaves can be moved in or out about 6 ft. This affords sufficient play so that forms can be swung into place after being hoisted to the top or, after removal, can be moved out so as to be lowered all the way in the clear.

The traveler was made up on the job of materials at hand, the crab was taken from an old flume gate, and the trucks came from small cars used on industrial tracks. As the traveler moves only occasionally and

TRAVELER MOVED ON PLANK RAILS

then without load, it was not considered necessary to make elaborate provision for track. Consequently the wheels run on 2 x 6-in. plank laid flat along the top of flume.

The flume work and the construction of the traveler have been under the direction of A. Griffin, chief engineer for the district, recently succeeded by R. W. Olmsted, formerly resident engineer on the flume job.

Wood Blocks on Bridge Floors Need Rigid Support

In designing and laying creosoted wood-block pavement on bridge floors experience indicates a few points which should receive attention, according to Clifford Older, Chief Highway Engineer of the Illinois Department of Public Works and Buildings, in a paper presented before the American Roadbuilders' Association at its recent convention in St. Louis. In such construction it is of prime importance that the floor on which the blocks are laid be sufficiently rigid to not deflect to a degree which will leave the blocks poorly supported, otherwise they will split under the traffic. As slight deflections of the floor are inevitable, a somewhat plastic cushion should be interposed between the blocks and the floor, in order that the bearing of the blocks may become adjusted to the deflections which occur under average traffic. Of a necessity, the greater the live-load deflections of a floor the greater becomes the need of plastic cushions.

It is the practice of the Illinois Highway Department to build the floor of 3-in. creosoted plank laid on stringers spaced from 2 to 2½ ft. apart. This planking is mopped with bituminous material and covered with a ¼-in. layer of bituminous felt, which is in turn coated with bituminous material before the blocks are laid. These are placed with a ½-in. expansion joint, as well as a larger expansion joint about 1 in. wide, along one curb. Sand cushions should be avoided, since the vibration of the bridge is sure to cause them to shift. However, a cushion of bituminous material and sand would probably be satisfactory if laid with proper care.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

First Big Concrete Hull Takes Water

The 5000-Ton "Faith" Launched Without Crack—Trial Trip as Soon as Machinery Can Be Installed

The first large concrete ship to be constructed in the world was launched Mar. 14 without mishap on the Pacific coast. The vessel, with a dead-weight cargo capacity of 5000 tons, is the one described in *Engineering News-Record* of Jan. 17, p. 105. The launch was made sidewise, and although the far edge of the deck rolled under water, the hull righted itself at once, the vessel being designed with a low center of gravity.

The hull floated on an even keel and drew the calculated number of feet and inches. The concrete walls of the vessel were just as they left the forms, except that several coats of waterproofing of various kinds had been given it. The hull is now at the wharf, being fitted out with engines. As soon as possible it will make a trip to sea under its own power under the supervision of government experts.

The builders announced to the press that they will begin the construction of a large number of similar ships. The vessel is 320 ft. long, 44.6 ft. wide, and is stated to contain about 540 tons of reinforcing steel and to weigh 600 tons more than a steel vessel of like capacity. It will burn oil, which will be carried in a 5000-bbl. reinforced-concrete tank.

The vessel, as was stated in the article referred to, was constructed by the San Francisco Shipbuilding Co., of of which W. Leslie Comyn is president.

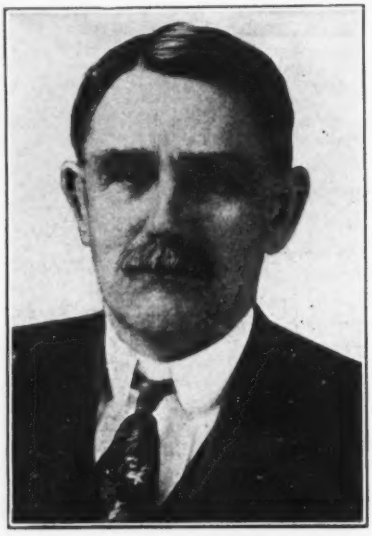
Engineering Contractors' Society Opens Office in St. Louis

Albert P. Greensfelder, the recently inaugurated president of the American Society of Engineering Contractors, has sent to the members and friends of the society a bulletin in which stress is laid upon the duties which, Mr. Greensfelder says, the engineering contractors should perform for the nation.

By action of the board of directors, at the annual meeting, it was decided to establish an office for the society in St. Louis as a more central location and from which prompt service would be available. An assistant secretary, L. W. Helmreich, who is an engineer, has been placed in charge.

Mr. Greensfelder announced in the first bulletin the intention to reach the members frequently through a bulletin service, criticism of which is invited.

C. A. Morse, Elected President of the American Railway Engineering Association



C. A. MORSE

The new president of the American Railway Engineering Assn., elected at the annual meeting in Chicago this week, is C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry. Mr. Morse was born in Bangor, Me., Jan. 1, 1859, and was graduated in civil engineering from the University of Maine in 1879. In May, 1880, he began work with the Chicago, Burlington & Quincy R.R., and was division engineer on construction during 1881. From November, 1881, to March, 1884, he held a similiar position on the Mexican Central Ry., but in May, 1884, he returned to his former position on the Burlington, where he remained until June, 1885.

On Jan. 1, 1886, he entered the employ of the Atchison, Topeka & Santa Fé Ry., and in 27 years' service he was successively division engineer on construction, division engineer in the operating department and on maintenance, resident engineer, principal assistant engineer, assistant chief engineer, chief engineer of the A., T. & S. F. Ry. proper, and finally chief engineer of the A., T. & S. F. Ry. System. On Apr. 1, 1913, he became chief engineer of the Chicago, Rock Island & Pacific Ry., and he still holds that position. He is a member of the American Society of Civil Engineers, and is now on the nominating committee of that society.

Mr. Morse believes in the engineer taking part in civic affairs, and as a member of the engineers' sub-division of the Chicago Association of Commerce he has been active recently in initiating a campaign against water waste. The Chicago Engineers' Club has made him president this year. In that organization he has fostered the idea of an engineers' building, to house all the technical societies of the city.

Funds Asked for Report on New York Port Needs

Port Commission Makes Statement—Wants States of New York and New Jersey To Act Soon

Early in 1917 the States of New Jersey and New York separately authorized the formation of the New York-New Jersey Port and Harbor Development Commission, consisting of three representatives from each state. Its duty should be the recommendation of a policy to be pursued by the two states and the United States, to the end that the entire port of New York "shall be efficiently and constructively organized and furnished with modern methods of piers, road and water and freight facilities, and be adequately protected in the event of war." Before making such a report the directors of the two commissions acting jointly were to make a thorough study of port conditions, employing therefor such engineering, legal and other professional assistants as might be required for the effective working out of a comprehensive adequate interstate and Federal port policy and plan.

Under these acts the commission organized in the summer of 1917 and appointed as chief consulting engineer Maj.-Gen. G. W. Goethals and as consulting engineer B. F. Cresson, Jr. With the small appropriation granted, the joint commission has been working on its problems since late last summer. It has started to look into the West Side terminal problem, helped to organize the War Board for the Port of New York, coöperated with the Federal Government regarding the operation of the port, made preliminary studies on the vehicular tunnel under the Hudson River, and investigated the question of the proposed union terminal in New Jersey with motor-truck delivery to Manhattan. It has just issued its preliminary report, outlining the future work of the commission.

The most important proposed work is a comprehensive report upon the port problems. Such a report the

commission considers most necessary and most urgent. While available studies are numerous, it is the commission's contention that they are not sufficiently rounded out or up to date to make more than bases upon which a new report should be made. It is purposed in such a new report to study the present comprehensive systems of improved facilities for a general handling of freight within the metropolitan port district. Among others are the following important projects: (a) a complete all-rail belt line system; (b) motor truck delivery; (c) an enlarged system of car-float and lighterage delivery by water. It is also purposed to survey and classify the amount and movement of freight through the port and the cost of port operation, and to work out a sound and profitable legal plan for combining the present distributive Federal, state and local powers of administration and construction.

In view of the large scope of the work and the importance of obtaining early results, the commission recommends that this study be undertaken at once, with the object of completing the report within two years. It states that obviously it will require a staff of engineers, draftsmen, inspectors and statisticians—in short, a large technical organization. In estimating the cost of such a report the commission has had the advice of a consulting engineer and has given very careful thought thereto. Each section of the commission definitely recommends, therefore, to its legislature that the sum of $400,000 be appropriated so that the comprehensive reports may be started immediately.

William R. Willcox of New York is chairman of the commission and J. Spencer Smith of New Jersey is vice-president.

Bridge-Raising Order Suspended

The War Department has suspended its order of a year ago requiring the Allegheny River bridges at Pittsburgh to be raised and rearranged with respect to pier spacing. The reason given for the suspension is the inadvisability of allowing the issuance of securities and the ordering of materials in competition with more urgent requirements. Of the city bridges, those at Sixteenth and Forty-third Sts. are affected, as they were the first on the reconstruction program and work was soon to begin. Raising of the Pittsburgh, Fort Wayne & Chicago R.R. bridge has already been completed.

Bill to Relieve Contractors

The bill enabling state, county and municipal authorities in New York to cancel construction contracts where the contractors have been placed in difficult circumstances as a result of the entry of this country into the European war, noted on p. 531 of *Engineering News-Record* last week, was introduced in the legislature of this state Mar. 14 and is now in committee.

Two More Suits Decided Against Luten Patents

Concrete Bridge Cases Defended by State of Kansas Dismissed for Want of Equity

In the District Court of the United States for the District of Kansas, First Division, Judge John C. Pollock on Feb. 27 dismissed for want of equity two suits brought by Daniel B. Luten against certain contractors for violation of some of the claims in two of the Luten patents on concrete bridges. The responsibility of defending these suits was assumed by the attorney-general of the State of Kansas under an act of the legislature of Mar. 10, 1917. The two patents were Nos. 818-386 and 853203; two claims were involved in each patent.

The first of these two was discussed at some length by Judge Pollock, the last part of his decision being as follows:

"Now, is the question presented as to the best method or manner of placing steel bars or rods in reinforcing a concrete arch to give it strength to support weight one capable of being definitely and certainly solved by the application thereto of well-known scientific principles, or must such question be worked out from experimental tests involving many changes in manner and form of employment until a happy (the best) form is chanced upon or discovered by the creative power of the mind as contradistinguished from its ability to understand well-known and settled scientific principles?

"From a study of the authorities I am of the opinion all the claims of the patent involved in this case disclose is a mere change of place of old elements in combination, producing perhaps a better but in no sense a new result. Further, that any mechanic of ordinary skill in the doing of the work would have developed the method employed from out of his understanding of such matters and in dealing with them. If this be true, as is seen from the authorities above cited, the claims to the patent in dispute are invalid and confer no monopoly of right in use upon the plaintiff. The motion to dismiss is sustained."

The second patent was dismissed "for the reasons expressed in the memoranda of opinion filed" in the preceding case.

Denver Union Water Co. Wins

The ordinance passed in 1914 by the city council of Denver, Colo., attempting to reduce by 20% the water rates charged by the Denver Union Water Co., was held invalid in a decision by the U. S. Supreme Court handed down on March 4. Justices Holmes, Brandeis and Clarke dissented, contending that the suit should be dismissed. The decision sustains the valuation of $13,415,899 fixed by a lower court on the findings of a master after extensive hearings. Under an agreement reached last year, the city has the option of buying the property of the company at the price established by the decision just rendered plus extensions and less depreciation, the option to be exercised within a year from the date of the decision. It is expected that an election to vote on the purchase will be held within a few months. During the proceedings in the lower court the company maintained that the rates named in the ordinance would yield only 2.88% on its investment. The special master figured the return at 3.64. The Supreme Court states that even if the disputed item of $1,998,117 for water rights (which it apparently did not pass on) be omitted the return would be only 4.28%, compared with 6% on secured real estate in Denver and also the 6% allowed by it in the Consolidated Gas Co. case, New York City. Such a low rate, the court holds, would violate the fourteenth amendment to the Constitution. The decision releases a large sum from impounded rates, said to be on $1,000,000, held for possible return to the consumers. There has been much litigation between the city and the company since the formation of the company in 1894. Preceding that date, there was a water-rate war between two competing companies, which finally consolidated.

Contracts Awarded for Columbus Channel Improvement

Contracts for the Scioto River channel improvement at Columbus, Ohio, have been awarded by the city on bids received Feb. 26, the second bidding. The larger part of the work was let to the W. E. Callahan Construction Co., Omaha, Neb.; the remainder went to D. W. McGrath, Columbus, Ohio, the total of the two contracts being $1,992,845. The Callahan concern was the successful bidder also in the first bidding, in December, but at that time could not perfect its contract by furnishing the required construction bond. Following the second award, however, the contracts with both concerns were executed and the necessary bonds filed; equipment is already on the way to Columbus to start the channel excavation. R. H. Simpson, engineer in charge of the channel improvement for the city, states that work will probably start by May 1.

To Appraise Water-Works

On the initiative of the city of Portsmouth, Va., steps have been taken for the appraisal of the waterworks of the Portsmouth, Berkley & Suffolk Water Co. The company has selected Leonard Metcalf, consulting engineer, Boston, Mass., as its appraiser. The city has chosen Charles F. Harper, Port Norfolk, Va. Mr. Harper is not an engineer. It is understood that the two appraisers will decide whether to choose a third appraiser at once or to attempt to reach an agreement themselves. L. C. Brinson is city clerk and auditor of Portsmouth.

Progressive Growth in Demand for Electric Power

O. C. Merrill Tells House Committee in Hearing on Water-Power Bill—Revenue Measure Favored

That a progressive increase in electric power consumption is taking place was brought out at a hearing on the so-called administration waterpower bill, now in progress before the joint waterpower committee of the House of Representatives at Washington, by O. C. Merrill, chief engineer of the Forestry Service, one of the authors of the bill, who was selected to make the statement for the Government in behalf of the Secretaries of War, the Interior and Agriculture, who are named in the bill as a commission to carry out its provisions. It was also brought out that Representative Sims, chairman of the committee, believes the bill should be made a revenue-producing measure.

Mr. Merrill presented several amendments to the bill proposed by the Government. The committee agreed to listen to addresses and discussions by a number of engineers and others interested in the waterpower industry. Mr. Merrill told the committee that the industrial expansion caused by the war has materially changed the pre-war status of the electric power industry. "The demand for power," Mr. Merrill said, "has increased notwithstanding increased costs of construction and operation. Increased operating costs have reduced the ratio of income to revenue, and this reduction combined with the decrease in the supply of available capital has produced a situation with respect to public utilities that merits the early attention of Congress." Mr. Merrill submitted tables showing fluctuations in the wholesale prices of 10 building materials and the advanced price level reached at the end of 1917. These advances, he showed, ranged from 45 per cent. for bricks to 147 per cent. for Douglas fir. Similar advances have taken place, Mr. Merrill said, in power plant equipment and hydraulic machinery. He also went into the increased costs of labor, coal and fuel oil. At the same time, Mr. Merrill said, "The demand for power has increased not at a uniform, but at an accelerating rate until during the past two years the annual increment in power generated by commercial central stations alone has been from three to four billion kilowatt hours, requiring an annual increase in installation of from one and one-half to two million horsepower." Mr. Merrill added: "The demand for power will continue to increase while war continues in order to supply power to our constantly expanding war industries, and when the war is over to provide for the extension of public utilities and of the electro-chemical industries, for the electrification of railroads and for the multitude of uses that will accompany the period of reconstruction."

The proposal for amendment to the bill made by the Government and outlined by Mr. Merrill on behalf of the Cabinet officers provides for preliminary permits for projects or parts of projects; specifies that the commission in considering applications shall select applicants "best qualified through ownership of necessary property"; makes it clear in the portion of the bill which deals with valuation of property for rate fixing that it is the net investment therein which is under consideration; and adds a paragraph to the bill as follows:

"In issuing licenses for a part only of a complete project or for complete projects of not more than 50 horsepower capacity the commission may in its discretion waive such conditions previous and requirements of this act as it may deem equitable in their customs."

It developed during the hearing that Representative Sims, chairman of the committee, has apparently made up his mind that the bill should be a revenue-producing measure. He stated that the people of the country are now heavily laden by the war, and opportunity ought to be taken for all possible revenue measures. Coincidentally it developed in Washington during the week that there is now a movement on foot among members of the Senate to combine some features of the Shields bill passed by the Senate some time ago with features of the Administration bill now under consideration in the House committee.

U. S. Public Health Service Wants Mosquito-Control Engineers

OFFICIAL STATEMENT

Owing to the early spring, the control of malaria is a pressing subject in the numerous areas in the districts where military and naval cantonments are situated. The sanitation of the areas surrounding these cantonments is being accomplished by the U. S. Public Health Service in coöperation with state and local health authorities.

The Public Health Service needs engineers to aid in the supervision of the necessary ditching, draining, and filling operations required by malaria control measures. The adequate control of malaria is essential to the maintenance of the health of troops in certain sections of the South and to the health of the civil population residing in districts adjacent to military cantonments. Helping to control the malaria situation is therefore an important piece of war work.

The Surgeon General of the Public Health Service is particularly desirous of securing without delay the services of engineers who have had experience in ditching and draining operations to assist in measures for the prevention of malaria in the districts referred to. This should give an opportunity to any engineers, including those who may have been refused military service because of slight physical defects, to aid materially in winning the war. All engineers, therefore, who would like to help the country by doing such work should communicate at once with the Surgeon General of the U. S. Public Health Service, Washington, D. C.

Commissions for Chemical and Mechanical Engineers

The engineering bureau of the office of the Chief of Ordnance of the War Department desires to obtain a number of technical graduates who, if accepted, are to receive commissions in the United States Army. Highly skilled chemical and mechanical engineers capable of engaging in research work, in the preparation of chemical compounds, and in the designing of intricate mechanical devices, are needed. These men must be graduates at least 25 years of age, must have an earning capacity of at least $1700 a year and must be in some other classification than 1A under the selective service law. A board of army officers will probably soon visit Chicago for the purpose of getting in touch with prospective candidates for these commissions. For preliminary interviews in Chicago apply to the Military Training Camps Association.

Cantonment Division Is Now the Construction Division

The War Department announced on Mar. 16 that the Cantonment Division of the Quartermaster's Department would hereafter be known as the Construction Division and would report to the Chief of Staff in the Army instead of to the Assistant Secretary of War, as it has been doing for the past month, or to the Quartermaster General as it did in the previous months of the war. This is in accord with the report from Washington on the reorganization of the Cantonment Division in *Engineering News-Record*, March 7, 1918, p. 482. The further effects of the change on the work of the division are not yet known.

Two Added to Waterways Committee

The membership of the United States Railroad Administration's Committee on Inland Waterways was increased from three to five on Mar. 13 by the appointment of Calvin Tomkins, at one time dock commissioner of the City of New York, and M. J. Sanders of New Orleans, the manager of the Leyland Steamship Line. This committee was appointed by Director McAdoo to make a rapid survey of the inland waterways situation with a view to recommending changes or improvements necessary to bring the waterway transportation into

accord with the railways. The chairman is Maj.-Gen. W. M. Black, chief of engineers, U. S. A., and the members are, in addition to the two new ones just appointed, Walter S. Dickey of Kansas City and E. A. Tomlinson of Duluth, Minn., with Brig. Gen. C. Keller as secretary.

Government Research Information Committee Formed

The Council of National Defense has announced that by joint action the Secretary of War and the Secretary of the Navy, with the approval of the Council, have authorized and approved the organization, through the National Research Council, of a research information committee in Washington, with branch committees in Paris and London. These committees are intended to work in close coöperation with the officers of the military and naval intelligence services, and their functions shall be the securing, classifying and determining of scientific, technical and industrial research information especially relating to war problems and the interchange of such information between the Allies in Europe and the United States.

The Washington committee consists of a civilian member, representing the National Research Council, with Dr. S. W. Stratton as chairman, the chief of the Military Intelligence Section, and the director of naval intelligence. In London the main representative is Dr. H. A. Bustead, and in Paris Dr. W. F. Durand. The headquarters of the committee are in the offices of the National Research Council, 1023 16th St., Washington, D. C., and the offices of the branch committees are situated at the American embassies in London and Paris.

Munitions Production Now in Ten Zones

The decentralization of the production of munitions under the Chief of Ordnance of the U. S. Army became operative on Mar. 10, by order of General Wheeler, acting Chief of Ordnance. The reorganization at present applies only to the production division of the Ordnance Department, but it is expected to extend over the other branches. Hereafter there will be ten zones in the United States, with district headquarters in New York City, Philadelphia, Pittsburgh, Cleveland, Rochester, Boston, New Haven, Detroit, Cincinnati and Chicago. In each of these cities a business man has been selected to be district chief of the production division of the Ordnance Department. Each division headquarters will have charge of the munitions manufacture and production in its district and will take care of conditions there, reporting to Washington. The finance division, the inspection division and the procurement division, other branches of the Ordance Department, will coöperate with the district offices and possibly will have field forces in the same district headquarters.

Among the men selected for the district chiefs are Ralph M. Dravo, of Dravo Bros., contractors, Pittsburgh; Samuel Scovil, of the Cleveland Illuminating Co., Cleveland; Waldo C. Bryant, president of the Bryant Electric Co., Bridgeport and New Haven, Conn.; E. A. Russell, vice-president of the Otis Elevator Co., Chicago; Samuel G. Allen, chairman of the Lima Locomotive Works, New York, and John C. Jones of the Harrison Safety Boiler Works, Philadelphia.

Keller Advanced to Rank of Brigadier General in National Army

BRIG. GEN. C. KELLER

Col. Charles Keller, Corps of Engineers, U. S. A., has been made a brigadier general in the National Army. General Keller has been stationed for some years past in Washington, in the Chief of Engineers' office, and has been particularly identified with matters pertaining to power legislation, power control and with the promotion of inland waterway navigation. He was secretary of the subcommittee on inland waterways of the Council of National Defense, and is now the secretary of the Committee on Inland Waterways of the United States Railroad Administration.

General Keller was graduated from West Point in 1890, the second in his class, and served in the Corps of Engineers successively as assistant in the Montgomery, Ala., Rock Island, Ill., Portland, Me., and Portsmouth, N. H., districts. His assignments then were: 1901-1903, in charge of Grand Rapids, Mich., district; 1903-1905, in Philippines as engineer of Moro Province; 1905-1910, in charge of U. S. Lake Survey and 11th Lighthouse District, Detroit; 1910-1913, Rock Island, Ill., district; 1913-1915, Mobile district, and on duty since that time at Washington, D. C. While at Detroit he had charge of the Niagara Falls power investigation, and while at Rock Island the Keokuk power dam was begun and completed. While he was at Mobile the last three locks and dams of the Warrior-Tombigbee navigation were completed and the system was opened to traffic.

Replacement Regiment Offers Chance for Foreign Engineering Service

The First Replacement Regiment of Engineers, organized at Washington Barracks Dec. 14 last for recruiting and training men to keep up the strength of organizations which have been sent abroad, has, according to its officers, not been able to secure the type of men needed, although the regiment is a necessity for maintaining the efficiency of the United States engineer personnel.

The regiment is expected to furnish enlisted men and non-commissioned officers for the following organizations:

Camouflage regiment; crane operating and maintenance regiment; depot detachments; electrical and mechanical regiments; forestry battalions; gas and flame service; general construction battalions; mining regiments; quarry regiments; searchlight regiments; supply and shop battalions; surveying regiments; water-supply companies.

Under army regulations it is stated that it is difficult for this regiment to secure a sufficient number of men from the National Army after the engineer companies attached to each division have been formed. On this account a call has been issued for volunteers to keep up the high standard of enlisted personnel in the engineer troops of this country.

Men who are not in the draft, whose experience is along the lines indicated above, should apply to the Commanding Officer, First Replacement Regiment of Engineers, Room 107, Headquarters Bldg., Post of Washington Barracks, D. C., for application blanks. If, when the man returns the blank, filled out, to the commanding officer, it shows that he is eligible for enlistment, the nearest recruiting officer will be instructed to accept him for service with this regiment. Transportation and meals will be furnished by the recruiting officer and the man ordered to report at the post for duty.

Attention is called by officers of the regiment to the fact that if this procedure is not followed the applicant who attempts to enlist may in many cases be assigned to some other organization and find it difficult if not impossible to effect a transfer.

The same applies to men of advanced classification in the draft, who may volunteer for service with the engineer troops exactly in the manner outlined above at any time prior to receiving orders to report at one of the cantonments.

Kansas City Improvements May Be Delayed

In spite of active bidding on the Twenty-third St. Trafficway, Kansas City, Mo., the contract may not be let in the immediate future, according to reports from well-informed sources. The fact that part of the cost is to be paid by the railways creates difficulties under the present governmental railway control. It will be necessary for the companies to refer the question of paying their share of the cost to the director general.

The same condition is likely to delay construction of the grade-crossing improvements at the Fifteenth St. and Indiana Ave. crossings of the Kansas City Terminal belt line. A recent court decision disposing of legal objections urged by the railway was expected to clear the way for immediate construction, but it now appears that nothing will be done until the Federal railway administration approves.

Studying Light, Heat and Power Plant for St. Paul

The city council of St. Paul, Minn., has directed the bureau of engineers of the department of public works to make an investigation and report on the feasibility and desirability of establishing a municipal light, heat and power plant, utilizing fully or in part the power which can be developed at the government high dam. The council has in view the taking over of all commercial and public lighting as a means of reducing electric light rates.

Cincinnati Rapid Transit Delayed by Court Decision

The ordinance passed by the city of Cincinnati making an agreement with the Cincinnati Traction Co. for the operation of existing street car lines and the proposed rapid transit system was on Mar. 5 declared illegal by the Ohio Supreme Court in so far as it provided for paying charges on securities of the company (both existing and subsequently issued) before paying rental on city-owned lines. This clause, which is in substance identical with the provisions of other recent coöperative traction agreements, notably that of Philadelphia, is declared by the court to be pledging of the city's credit. The syllabus of the decision says:

"An ordinance of a city providing for the grant to a street railway company of the right to operate jointly a subway or street railway owned by the city, with a system of street railways already owned and operated by the company, which provides that the gross proceeds from the operation of such properties shall be used for the payment of existing and hereafter issued securities of the company, is a pledging of the city's credit for the private debts of a street railway company, in violation of Sec. 6, Article 8, of the Constitution, which prohibits a city by vote of its citizens or otherwise from raising money for or loaning its credit to or in aid of any company, corporation or association."

The part of the State Constitution in question is a portion of the revision adopted in September, 1912.

The remainder of the decision upholds the ordinance in so far as it provides for regulating the operation of the joint system by an administrative board of rapid transit commissioners. The court says that the ordinance in establishing such a board does not thereby delegate legislative power in violation of the constitution.

Yonkers Plans Waterfront Commission

The City of Yonkers, N. Y., a port lying north of the City of New York on the Hudson River, continues to prepare for an enlargement of its waterfront facilities. On Mar. 12 the Board of Aldermen approved a legislative bill proposed by the mayor for the appointment of a commission of five men to prepare preliminary plans for the development of the Yonkers waterfront. The bill gives to the mayor the power to appoint the commission, the members of which shall serve without compensation. The commission is to prepare plans for a marine terminal and the improvement of the entire waterfront and report its findings to the mayor and common council, along with estimates of the probable cost of the work. It is to serve until 1922 and will be allowed a sum not exceeding $10,000 each year for operating expenses.

For Greater Protection of Nashville Water-Supply

A carefully devised plan to treat the trade wastes and sewage from the Government powder plant at Hadley's Bend, on the Cumberland River above Nashville, Tenn., and the substitution of an automatic liquid chlorine plant for hand-operated hypochlorite closing of the water-supply of Nashville, Tenn., have been recommended by E. B. Phelps of the U. S. Public Health Service. A suggestion is made concerning possibilities of utilizing the acid waste from the powder plant for disinfecting the sewage and recovering grease from it. The use of liquid chlorine for water treatment is advised as a matter of greater safety and not because the typhoid statistics of Nashville reflect an impure water-supply.

Airplane Mail Service Delayed

The start of the airplane mail service between New York, Philadelphia and Washington will be delayed probably as late as May 15 because landing fields at Philadelphia and New York have not been found. The service was to have been begun Apr. 15.

Commission Recommends Highway Tunnel Across Hudson

Construction of a vehicle tunnel under the Hudson River between New York and Jersey City is recommended in a report just made to the New York legislature by a state bridge and tunnel commission, of which Gen. George R. Dyer is chairman. Gen. George W. Goethals was consulting engineer to the commission. The recommendation agrees with one made to the New Jersey legislature by a special commission of that state two months ago. New Jersey has already appointed a new commission to proceed with the construction of the tunnel as soon as joint action by New York is assured.

The proposed tunnel extends from Canal St. at Varick St., New York City, to 12th St. at Provost St., Jersey City, a distance of about 10,000 ft. The approach grades are 3½% on both sides, and the maximum depth of tunnel bottom below low-water is about 92 ft. The recommended section is a single, circular tunnel, 36 ft. in diameter inside and 42 ft. outside, the wall being made of segmental concrete blocks 3 ft. thick. The tunnel is to have two traffic levels, each accommodating three lines of vehicles. A proposal for the construction of the tunnel has been secured from a well-known contractor, at $12,000,000.

Trench Method Not Practicable

General Goethals reports that the trench method of constructing the tunnel, by dredging a trench in the river bottom and placing in it sections of tunnel built on shore, connected up after placing, is not practicable because the Hudson River silt is too soft to permit of excavating and maintaining such a trench. For this reason the shield method of tunneling is recommended and the circular tunnel section adopted.

The capacity of the tunnel is estimated at about 100,000 vehicles daily. Counts of ferry traffic over the five lines nearest the tunnel show 4800 vehicles going in each direction per day. A traffic of 4000 vehicles in each direction through the proposed tunnel is counted on for the year 1922, the expected time of completion. The traffic is further estimated to increase 5% each year. With a toll of 30c. per vehicle, stated to be somewhat under the present ferry rate, a revenue sufficient to retire a bond issue of $6,300,000 in 20 years is computed. This figure represents one-half the cost of the tunnel and real estate. Coöperation by the United States to the extent of half the cost is expected by the commission.

The report asserts that the past winter's coal troubles were closely related to the inedaquacy of means of vehicle transfer across the Hudson: "Twelve months ago no one would seriously have urged that the city could be in the grip of a coal famine involving in its financial features alone the loss of many times the total cost of construction of the proposed tunnel.

and that this could be largely due to its inability, because of the ice-choked river, to transport thousands of tons of coal that were literally within sight of its inhabitants and yet as unattainable as if they were still in the mines.

"It may truly be said that without considering the death, sickness and physical suffering resulting from this condition of affairs, but merely the financial losses as stated in the press, the cost of the tunnel could easily have been paid out of any one of a dozen days' losses in the month of January, 1918, resulting entirely from the inability to move coal barges about the harbor and rivers. This loss might have been substantially avoided if motor vehicles could have received the coal at tidewater in New Jersey and delivered it through the traffic tunnel direct to the consumers in the city."

Chicago Drainage Canal and Canadian Officials Confer

Following the adverse reception with which the army engineers recently received the proposal of the Sanitary District of Chicago to carry out their own recommendations to build submerged weirs in the St. Clair and Niagara Rivers to offset diversion at Chicago, District and Canadian officials have discussed the problem at Montreal. This was done because the chief objection raised to the Chicago proposal was that it violated a treaty with Great Britain.

All other interests in the Great Lakes seem to have been satisfied, but it now appears that the engineers in developing the Montreal harbor and a 35-ft. waterway are the real objectors.

For a few months in the year low water prevails, a few inches of which is attributed to the Chicago diversions. In the conference it was brought out that probably the construction of controlling works, including a weir and bypass, may not only eliminate some of the present ice jam difficulties but also solve satisfactorily more of the Montreal harbor low water troubles than was at first anticipated.

At any rate, engineers were dispatched from Chicago Mar. 9 by George M. Wisner, chief engineer, sanitary district, to obtain hydraulic data and local topography. Mr. Wisner is optimistic over the prospect of a favorable solution.

Warehouse Company in St. Paul to Electrify Trackage

Electric operation is to be substituted for steam on the tracks of the Central Warehouse Co. in St. Paul. The company has a large lumber terminal and warehouses served by 21 tracks leading from the Minnesota Transfer Ry. A contract has been let for the electrification, and one of the two locomotives ordered has been delivered. It is believed that this is a forerunner of general electrification of the Minnesota Transfer.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; May 20-25, St. Paul, Minn.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; June 24-26, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 25-28, Atlantic City, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Spring meeting, June 4-7, Worcester, Mass.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS; 129 York St., Brooklyn, N. Y.; June 19-22, Berlin, N. H.

The paper detailing the growth and changes in the pumping plant of the water-works of Manchester, N. H., read before the **New England Water-Works Association**, Mar. 13, promises to be of considerable value as a historical document when printed in the *Journal* of the association. The subject of frozen pipes was raised. Discussion enough to occupy the entire session could have been obtained. It was voted that a committee should be appointed to gather experiences with frozen pipe during the past winter, which have been more serious in southern New England than during the cold weather of eight or ten years ago. In the vicinity of Boston the frost has penetrated to a depth of 6 ft. and more. President C. E. Davis announced the appointment of the committee as follows: Frank J. Gifford, chairman; D. A. Heffernan, Thos. E. Lally, Frank A. McInnes.

At a joint meeting of The Detroit-Ann Arbor Section, American Institute of Electrical Engineers and **The Detroit Engineering Society,** held Mar. 15, Eskil Berg, of the turbine engineering department of the General Electric Co., Schenectady, N. Y., spoke on "Recent Developments of Machinery for Ship Propulsion." The matter of electrically driven ships was discussed and also electrical controls used in many places on modern battleships.

The Canadian Society of Civil Engineers, meeting in Montreal, Mar. 14, was addressed by Commander J. W. Skentelbery, Royal Navy, on the subject, "Engineering Activities in Connection with the Work of the Navy." Commander Skentelbery is a member of the British Institution of Naval Architects, and represents the British Navy in the Dominion of Canada.

The Indiana Sanitary Water Supply Assn. will hold its annual convention in the Claypool Hotel, Indianapolis, Mar. 27-28. The association is composed of Indiana mayors, city engineers, water-works and public health officials, and other interested citizens.

At the Mar. 13 meeting of the **Engineers' Society of Milwaukee** Prof. Cyril M. Jansky, assistant professor of electrical engineering, University of Wisconsin, gave an illustrated talk on "Science in War." There was also an exhibition of a film showing the electrical division of the Chicago, Milwaukee & St. Paul Railway.

The Providence, R. I., Engineering Society was addressed Mar. 4 by R. L. Beeckman, Governor of Rhode Island, who told of his experiences on the European war front. Calvin W. Rice, secretary of the American Society of Mechanical Engineers, spoke on the need of technically trained men in the war. The formation of a clearing house committee to obtain contracts for war work for local industries was advocated.

The Brooklyn, N. Y., Engineers' Club held Mar. 21 a regular meeting at which John C. Shevlin, president of the Shevlin Engineering Co., Inc., presented an illustrated paper on "Economical Combustion of Coal." On Mar. 21, "Concrete Pressure Pipe" will be described with the aid of lantern slides and discussed by A. M. Hirsh, treasurer, Lock Joint Pipe Co., Ampere, N. J.

The Society of Industrial Engineers and **The Western Efficiency Society** have arranged for a conference on "Labor Problems under War Conditions." It will be held at the LaSalle Hotel, Chicago, March 27-29. With the conference there is to be an exhibit of labor-saving equipment for office and factory use. George C. Dent, 327 South La Salle St., Chicago, is conference secretary.

The Levee and Drainage Contractors' Assn. of the United States will hold a conference at St. Louis, Apr. 23-24 for the purpose of demonstrating how the food production of the nation may be increased by bringing under cultivation millions of acres of arable land now uncultivated because of overflow or too much water. All who are interested in this purpose are invited to participate in the conference. The president of the association is Otto Kochtitzky, Cape Girardeau, Mo.; C. S. Gannon, 421 National Bank of Commerce Building, St. Louis, Mo., is secretary and treasurer.

The St. Paul Chapter of the American Association of Engineers will hold its second convention at the Commercial Club, Apr. 3. F. K. Bennett, principal assitant engineer, Minneapolis & St. Paul R.R., has been nominated for president. The request of members in Minneapolis for a separate chapter will be discussed.

The Vermont Society of Engineers held its sixth annual convention at Burlington, Mar. 13. Among the important matters discussed at the convention was that of the need of rebuild-

ing the highways of the state in view of military needs. A. E. Winslow, the retiring president, spoke on "The Engineer of Today," following a lecture by Charles H. Nichols, New York, on "Modern Fireproof Buildings." B. M. Hayward, Montpelier, research engineer of the Central Vermont Ry. valuation department, was elected president of the society. G. A. Reed, Montpelier, assistant state engineer, is secretary.

The Engineers' Club of Trenton, N. J., at a special meeting Mar. 14, was addressed by Dr. David B. Steinman, New York City, on "Historical Sketch of the Art of Bridge Building."

The governing committee of the **New York Section of the American Water Works Assn.,** at its meeting Mar. 7, elected the following officers for the ensuing year: President, William W. Brush, deputy and acting chief engineer, Department of Water Supply, Gas and Electricity, New York City; secretary, Edward S. Cole, president of the Pitometer Co., New York. Allan Hazen has been president for the past two years and retired at the expiration of his term of office as a member of the governing committee.

Dallas was selected as the future headquarters of the **Texas Association of Members of the American Society of Civil Engineers** at its annual meeting held in Dallas Mar. 9. The following officers for 1918 were elected: R. C. Gowdy of Fort Worth, president; J. H. Brillhart of Dallas, secretary and treasurer. At the meeting Prof. R. G. Tyler of the University of Texas read a paper on "Purification of Sewage by Aëration in the Presence of Activated Sludge," and J. C. Nagle, dean of the school of engineering of the Texas and Mechanical College, read a paper on proper legislation for licensing engineers for the protection of the profession and the public.

Major Rothrock of the Construction Quartermaster Department of the Army, told of the rapid work done in constructing the cantonment at Camp Logan, Houston, and Terrell Bartlett read a paper on the relation of rainfall to runoff.

On Mar. 11 Prof. John R. Allen, dean of the college of engineering and architecture, University of Minnesota, addressed the **Civil Engineers' Society of St. Paul, Minn.,** on "Heating and Ventilating of Residences and Other Buildings."

The Providence, R. I., Engineering Society on Mar. 22 will be addressed by G. Douglas Wardrop, New York, editor of *Aerial Age*, on "The War in the Air." On Mar. 27 the municipal engineering section of the society will hear Frederick N. Connet, manager of the Venturi Meter department of the Builders' Iron Foundry, on "Recent Developments in the Use of the Venturi Meter." The lecture will be illustrated. On Mar. 28 the efficiency section of the society will hold a social meeting and will be addressed by W. H. Harriman of the Universal Winding Co., who will tell of his personal experiences in engineering in Mexico.

The Canadian Society of Civil Engineers will hold its annual meeting for Ontario, at Toronto, Mar. 26-27, for the discussion of the present fuel and power situation. The opening address will be delivered by Sir William Hearst, prime minister of Ontario, and there will be fourteen other addresses by prominent Canadian engineers.

On Mar. 19 **The Western Society of Engineers** held a meeting at which "Meeting the Material Situation" was discussed, following the presentation of the work and purpose of the Priority Division of the Council of National Defense and the administration of priority regulations governing the distribution of construction materials. Three papers were presented on the subject, "What the Engineer Can Expect from Industries Supplying the Basic Engineering Materials." "Structural Steel Plants" was the subject of F. J. Llewellyn, division contracting manager, American Bridge Co.; "Lumber Industry" that of Herman von Schrenk, consulting timber engineer, and "Concrete" was the subject of B. F. Affleck, president Portland Cement Association.

The last of the series of lectures on aviation at **The Lewis Institute, Chicago branch of the Western Society of Engineers,** had for its subject the development of the airplane engine. The lecturer was John D. Nies. He spoke on Mar. 14.

The Associated Engineering Societies of St. Louis were the guests of the Collimation Club, Mar. 20, at Washington University. J. A. L. Waddell, consulting engineer of Kansas City and New York, delivered an address on "The Engineering Profession Fifty Years Hence."

PERSONAL NOTES

A. R. EITZEN, former office engineer in the bridge department of the Kansas City Terminal Ry., has been made bridge engineer of the Missouri, Kansas & Texas Ry., with headquarters at Dallas, Texas.

CHARLES S. HENNING has been made chief engineer of the New Mexico Central Ry., with office at Santa Fe.

H. L. SWEET, until recently of Pekin, Ill., has been elected city engineer of Okmulgee, Okla.

W. R. KRAMER has become an assistant engineer at Dayton for the Miami Conservancy District. He is a graduate of Valparaiso University, and was formerly engaged in Government work.

J. O. JONES, assistant professor of hydraulics at the University of Kansas, has accepted an appointment as testing engineer at the Government munitions plant under construction at Charleston, W. Va. He is the second Kansas University School of Engineering man to be called by the Government for work on this war munitions plant, Prof. C. C. Williams, in charge of railway engineering at the university, having been called recently to act as superintendent of the plant.

H. A. LA RUE has accepted a position as testing engineer for the Missouri Highway Commission with headquarters in the Highway Materials Testing Laboratory at the University of Columbia, Missouri. Mr. La Rue has been representing the Portland Cement Assn. in Kansas.

E. LESTER JONES, superintendent of the United States Coast and Geodetic Survey, has been commissioned a lieutenant-colonel in the Signal Corps, U. S. A.

GEORGE CHAMPE, Toledo, has been engaged by the mayor and council of Vermilion, Ohio, to prepare paving plans.

G. F. AYER, Galesburg, Ill., who has been superintendent of the Illinois division of the Atchison, Topeka & Santa Fe Ry., has resigned to become superintendent of a canning plant at Cape Fanshaw, Alaska.

ROBERT L. THOMAS, who was for two terms city engineer of Eureka, Calif., has returned to Eureka and will open an office there.

MORTON R. MAVOR, Chicago, has been commissioned major in the Engineer Corps, National Army.

T. D. HAWKINS, formerly chief engineer of the United Verde Copper Co.; J. J. Stanton, up to a month ago master mechanic of the same company; W. J. Jamison, who was a United Verde engineer before his appointment to the commission on state institutions of Arizona by former Governor Campbell; W. R. Fleming and F. S. Stitzer, contractors, have organized the Southwestern Engineering & Construction Co. Offices will be maintained in Phoenix, Prescott and Jerome, Ariz.

CHARLES F. BREITZKE, in charge of the sanitation of the Jersey City watershed for the past five years, has been assigned by Commissioner Fagen to the position of acting sanitary adviser to the Jersey City water department, in succession of Willard C. Mallalieu. The latter, who has had charge of the city water-works laboratory in Jersey City, N. J., since Dr. George E. McLaughlin enlisted as a lieutenant in the navy, left Mar. 14 for Camp Greenleaf, Georgia, to assume the duties of captain in the National Army, assigned to the sanitary corps.

MORRIS L. COOKE, Philadelphia, who has been serving for some months on the storage committee of

the Council of National Defense, has resigned and will go to the Emergency Fleet Corporation to assist the general manager with organization matters.

LEON F. HAMMOND, formerly with the U. S. Forest Service at Gorham, N. H., is now with the U. S. Coal & Coke Co., Lynch, Ky.

B. M. ATWOOD has been appointed state engineer of Arizona, succeeding Lamar Cobb, who resigned to enter private practice in Phoenix.

THOMAS L. AMISS, heretofore assistant superintendent of the Shreveport, La., water department, has succeeded W. R. Goss as superintendent.

JOHN C. TRACY, head of the department of civil engineering in the Sheffield Scientific School of Yale University, has been granted leave of absence by the university in order to enable him to become the executive head of the New Haven war bureau of the Connecticut State Council of Defense. Professor Tracy was formerly professor of structural engineering in the Sheffield Scientific School, and became head of the department in 1915, when he succeeded the late Prof. A. J. DuBois. He was graduated from the school in 1890 and received the degree of civil engineer in 1892. After engaging for a time in bridge construction work he became assistant on the school faculty in 1892, instructor in 1894 and professor of structural engineering in 1915.

GROVER E. BEAR has resigned his office of assistant city engineer of Allentown, Penn., department of sewers and surveys, and has become associated with the Fuller Engineering Co. with main offices at Allentown, Penn. His resignation became effective Mar. 15.

JOHN BERG, assistant engineer with Ralph Modjeski, Chicago, is spending part of his time with the board of engineers, Quebec Bridge, Montreal, in connection with work on the technical data for the official report on the design and construction of the bridge.

CLAUDE G. BENHAM, formerly assistant chief engineer of the Virginia Railway & Power Co., Norfolk, Va., is now a captain in the Coast Artillery Corps, U. S. A., at Fort Monroe, Va.

WILLIAM C. GROENIGER, state plumbing inspector of Ohio, has been commissioned captain and appointed a member of the expedition of sanitary engineers and doctors which will begin the work of establishing modern drainage systems and securing adequate pure water supplies for Palestine.

P. B. BRENEMAN, professor of mechanics and materials of construction at the Pennsylvania State College, has been appointed in install, organize and operate a department of tests for the naval aircraft factory in the U. S. Navy at League Island, Philadelphia, Penn. He has been granted a leave of absence to do this work.

FREDERICK W. SIMONDS, of Ridgewood, N. J., has been appointed city engineer of Rahway, N. J. He is a graduate of the Massachusetts Institute of Technology and was an engineer in the construction and maintenance department of the New York Central railroad. He was also municipal engineer of Ridgewood, N. J.

R. CLYDE HARVEY, formerly of Wadsworth, Ohio, has become city engineer of Kent, Ohio. He is a graduate of Ohio Northwestern University.

PEARSE & GREELEY, Chicago, have been selected to act as consulting engineers in the preliminary work for the construction of the proposed impounding dam for the water system of Jacksonville, Ill.

H. A. PERKINS, for the past four years city engineer of Leavenworth, Kan., resigned Feb. 26. He will engage in the motor car business in Leavenworth.

OBITUARY

WINFIELD SCOTT CHAPLIN, former dean of Lawrence Scientific School, Harvard University, and retired chancellor of Washington University, St. Louis, Mo., died Mar. 12. He was graduated from the United States Military Academy in 1870. He served in the army several years, and in 1874 became professor of mathematics at the University of Maine. From 1887 to 1893 he was professor of engineering at the Imperial University, Tokio. Later he was in the engineering department at Union College, in Schenectady, N. Y., and dean of Lawrence Scientific School. Professor Chaplin was born at Glenburn, Me., Aug. 22, 1847.

C. P. MCCULLY, special agent in the office of the general superintendent of transportation of the Pennsylvania Railroad, died Mar. 8 at Bala, Penn. Mr. McCully had been in the service of the Pennsylvania Railroad nearly 47 years, having been first employed on July 17, 1871, as rodman, on what is now the Pittsburgh division. After promotion to assistant supervisor, Mr. McCully in 1878 was made supervisor in the Altoona yards. In 1881 he was transferred to Philadelphia as chief clerk to the general superintendent of transportation, remaining in that capacity for 35 years. On Feb. 16, 1916, he was made special agent.

FREDERICK ENDICOTT died Mar. 12 at Canton, Mass. He was born in 1839 and began his career as a civil engineer by surveying for the late Henry F. Walling. Later he measured the carriage road from the Glen House to the summit of Mt. Washington, for the state map of New Hampshire.

In his home town, Canton, he had held many offices, including that of selectman, also superintendent of schools, water commissioner and hydraulic engineer for the town water-works.

JOHN T. KINDER died Mar. 12 at Noblesville, Ind. For fifty years he was superintendent of bridge construction work on the Lake Erie & Western Railroad.

POMPEYO SARIOL Y SILVA, civil engineer, Camaquey, Cuba, died Feb. 26. He was a graduate of Rensselaer Polytechnic Institute.

HUGH C. SMITH, who was at one time a member of the Louisiana State Board of Engineers, surveyor of the Louisiana Oyster Commission and who took an active part, as engineer, in many of the improvements in Louisiana and Mississippi, died Mar. 2 in New Orleans. He was a native of Mississippi and was 58 years old. He had charge of the survey of Natchez, Miss., harbor for the U. S. Government and later was engaged in survey work for various railroads. He was at one time chief engineer of the Louisiana Conservation Commission.

REAR ADMIRAL JOHN ADDISON BAXTER SMITH, U. S. N., retired, died in New Orleans Mar. 9. He was born in Baltimore, Md., in 1843, and entered the naval service as a third assistant engineer in 1863. He became a chief engineer in 1892, and in 1899, when the engineer corps was abolished, he was transferred to the line with the rank of commander. He was promoted to be captain June 8, 1902, and until 1908, when he retired as a rear admiral, he was president of the board on changes in machinery of vessels building on the Atlantic coast, and had full charge of reconstructing and building the machinery of the department. He built the machinery for the battleship Connecticut. Rear Admiral Smith was a member of the Society of Naval Architects and Marine Engineers and the American Society of Naval Engineers.

NELSON J. ROSCOE, probably the oldest surveyor and civil engineer in the United States, died in New York Mar. 18 in his ninety-ninth year. He was a surveyor on the Union Pacific Railroad during its construction and later for the Missouri, Kansas & Texas Railway.

JOSE LOMBILLO CLARK died recently in Cuba. He was a well-known civil engineer of the island and held the office of director of public works in the administration of President Palma and during the second American intervention. Recently he was associated with Jose M. Tarafa, being technical adviser to the latter in several of his enterprises, chief among which was the Northern Railway.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Coal Will Be Conserved for the War Industries

100,000 More Tons a Day Needed—Representative of War Industries Board States Plans

In reply to numerous letters from manufacturers regarding the Government's definition of essential and non-essential industries and the possible curtailment of production this year, Waddell Catchings, industrial representative of the War Industries Board, says in an open letter to the industrial field:

"Certainly no industry is 'non-essential' to the workmen and capital employed therein, and when one considers that over ten million people and thirty billion dollars of capital are employed by 'non-war' industries, the need of caution in dealing with this problem is manifest.

"On the other hand, our industrial equipment is limited. We do not have materials, machinery, transportation, labor or capital sufficient for fighting the great war and for normal business at the same time. The war must be prosecuted to the utmost and business must shrink to provide the necessary equipment with the least possible injury to the business of the country.

Meeting Wartime Needs

"The first consideration of the nation and all of its industries must be to contribute the utmost toward winning the war, and to that end business must, where necessary, be diverted from its established channels into new channels; or if absolutely necessary, the flow must, during the war, be entirely stopped in order to provide adequate labor and material for war needs. It does not, however, follow that there will be less business than usual, but rather more unusual business.

"If the so-called 'non-essential' industries are 'cut off' many of them would be ruined and others permanently crippled.

Conservation in Many Lines

"The Commercial Economy Board of the Council of National Defense has undertaken to coöperate with business men in eliminating, as the Government's requirements demand, needless uses of men, materials, equipment, and capital in all lines of commercial business; in other words, to conserve commercial resources as necessary to meet the Government's need.

"On account of transportation conditions, the United States according to the Fuel Administration, will probably mine little if any more coal in 1918 than in 1917.

"1916 coal production approximately 575,000,000 tons.

"1917 coal production approximately 630,000,000 tons.

"1918 coal production approximately 630,000,000 tons.

"War industries and railroads must have at least 100,000 tons per day more than they had in 1917, or the flow of war necessities will be dangerously interrupted. This increase must be met by curtailment of the so-called 'non-essential' production and by economy at every furnace door, both household and industrial.

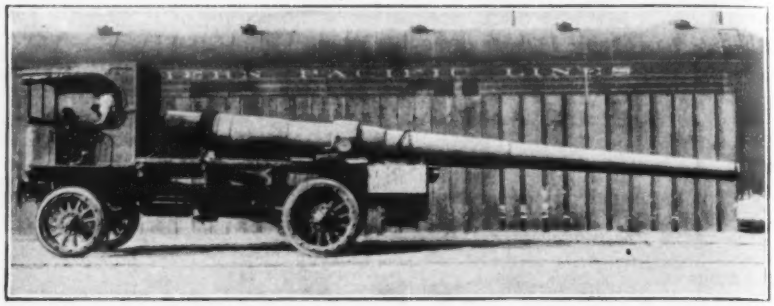
"The demands for 1918 to carry out the program for the production of necessities for the war, in addition to the normal business, would greatly exceed any possible production and distribution of fuel, so there is but one remedy—to limit the production of non-war industries sufficiently to provide for war needs, direct and indirect, and necessities for the public welfare and domestic consumption.

"In accomplishing the desired end, it should be our effort to divert the energies of non-war industries as far as possible to the production of the essentials for war, that each industrial center may use existing facilities, with its labor living at home, happy and contented."

Licenses Needed for Explosives

In order to prevent explosives falling into the hands of disloyal persons stringent regulations have been put in force by the Government, under the explosives act. The Bureau of Mines has received jurisdiction over the sale and use of explosives.

A purchaser's license must be obtained by every person receiving or purchasing explosives, but does not authorize the holder to sell or issue to others except to a licensed foreman. Special licenses must be obtained by every foreman having charge of blasting operations. The foreman or purchaser must be known to the local licensing agent or be properly identified to him.



10-TON LOAD CARRIED ON 5-TON TRUCK

Big Guns Handled by Truck with Short Wheelbase

"Somewhere on the Pacific Coast," the Government faced the problem of moving four 28-ft. guns, weighing 10 tons each, a distance of seven miles over roads so winding that it constituted a very difficult job. The sharp turns practically prohibited the use of a reach truck. Several hauling contractors gave it up but the King Drayage Co. agreed to tackle the job with a standard Garford 5-ton truck.

The haul was from a beach in sand varying from 3 to 9 in. in depth, over a very winding road to the highway. This could only be negotiated by a short wheelbase truck on account of the turns, and even so at times the front of the truck and the end of the gun were rubbing the bank.

The haul took five hours to a gun. The removal of the four guns occupied only two days.

Recommends Stopping Railroad Valuation Work

Philadelphia Bourse Urges Passage of Bill Checking Government Inventory Still Far from Completion

Declaring that continuance of the work of making a physical valuation of the country's railroad systems, authorized by Congress several years ago, would involve an expenditure of upward of $50,000,000 at a time when this money could be used for more important purposes, directors of the Philadelphia Bourse have adopted and forwarded to Washington vigorous resolutions urging that Congress repeal the law providing for the valuation.

A bill providing for the repeal of the physical valuation act has been introduced, and the Bourse makes an earnest plea that it be favorably acted on.

Physical valuation of all the railroads was authorized by Congress on Mar. 1, 1913. The work has been in progress since shortly after the enactment of this legislation and is still far

from completion. The resolutions adopted by the Bourse were forwarded to Director General McAdoo and also to members of the Pennsylvania delegation in Congress.

Shorter Timbers Allowed in Wooden Ships

Shipping Board Hastens Work by Changing Specifications—Permits Laminated Construction

As a result of a conference between the Shipping Board and members of the Southern Pine Assn., modifications were made in the ship timber requirements in order to speed up wooden ship construction on the Atlantic and Gulf coasts. The new ruling by the Shipping Board permits the use of laminated or "built-up" construction in ship framing, doing away with the necessity for extremely large sizes in timbers originally specified for the Ferris-type ship, which were only procurable in the far West. The changes in structural methods were granted after a conference in Washington between officials of the Shipping Board and representatives of the association.

Under the new rules the Southern Pine manufacturers have pledged themselves to produce material sufficient to build at least 300 modified Ferris-type ships a year. Eliminating the extreme sizes of timbers from the wooden ship specifications not only facilitates greater production and more rapid work in southern shipyards already in operation, but is expected to result in the establishment of numerous additional yards.

12% Dividend for Troy Wagon Workers

A dividend to employees, based on 1917 wages paid, was declared Mar. 15 by the Troy Wagon Works, of Troy, Ohio. The dividend was based upon length of service, employees who worked the entire year receiving 12% of their wages, those working 6 months getting 6%, and those employed one month, 1%.

Monorail Electric Hoist Manufacturers Organize

To coördinate in war work and to standardize their equipment in order to expedite production, an association of manufacturers of monorail electric hoists, known as the Electric Hoist Manufacturers' Assn., was organized recently. At the request of the War Industries Board the association is compiling data concerning the productive capacity of the various plants as well as the effect which priority orders and embargoes on shipments have had upon the trade.

The members are: the Brown Hoisting Machinery Co., Detroit Hoist & Machine Co., Euclid Crane & Hoist Co., The Franklin-Moore Co., Link Belt Co., Roeper Crane & Hoist Works, Shepard Electric Crane & Hoist Co., Sprague Electric Works, and the Yale & Towne Mfg. Co. The following officers were elected: F. A. Hatch, Shepard Electric Crane & Hoist Co., chairman; F. W. Hall, Sprague Electric Works, vice-chairman; C. W. Beaver, the Yale & Towne Mfg. Co., secretary-treasurer.

Meetings will be held monthly.

Bulky Exhibits Are Barred at Water-Works Conventions

No heavy or bulky exhibits will be permitted at the annual convention of the American Water-Works Association to be held at St. Louis, May 13-18, or at the Southwestern Water-Works Association convention at Tulsa, Okla, Apr. 23-26. The limitation of exhibits to pictures and small samples, such as a salesman may carry, was decided upon by the exhibit committee of the Water-Works Manufacturers' Association at a recent session in New York. The step was taken in order to aid the government in relieving freight congestion.

Limestone Men Present Case of the Building Industries

Secretary McAdoo and Members of Congress Hear Indiana Committee on State of Business

A committee representing the building and business interests of Bedford, Ind., the Indiana limestone center, recently discussed with members of Congress and Secretary McAdoo the state of the general building industry and the Indiana limestone situation.

It was stated that 4000 men were idle in Lawrence and Monroe counties, Indiana, whereas 5000 were employed on limestone production at this season in other years.

There was some discussion on the present general policy of discouraging all commercial building operations. The committee made it clear that it did not expect normal activity, but believe that industry should be permitted to live so long as it does not interfere with war work. It was stated that 50,000 men in the building crafts were out of work in Chicago.

It was pointed out to Mr. McAdoo that the building industry involves an annual wealth-producing turnover of $2,000,000,000, employing directly an average of 1,500,000 men, earning probably $6,000,000 daily, and that no nation can weather the sudden, almost total extinction of such a vital factor of its industrial establishment.

There was incidental reference to the activities of the capital issues committee of the Federal Reserve Board. Mr. McAdoo asserted that the duties of that committee are purely of an advisory nature, that there is nothing compulsory in its pronouncements, that no work had been prohibited, and that it is his desire and that of the Government to "maintain the poise of industry."

Structural Shops 55½% Full

The record of the Bridge Builders and Structural Society, as collected by its secretary, shows that during last month 55½% of the entire capacity of the bridge and structural shops of the country was contracted for.

BUSINESS NOTES

Harold L. Bond, president of Harold L. Bond Co., Boston, has been appointed manager for the New England district of the division of production, U. S. Shipping Board, Emergency Fleet Corporation. He will devote all of his time to the work. All contracts for equipment placed with New England manufacturers, whether intended for ships being built in New England or in other parts of the country, will come under its jurisdiction.

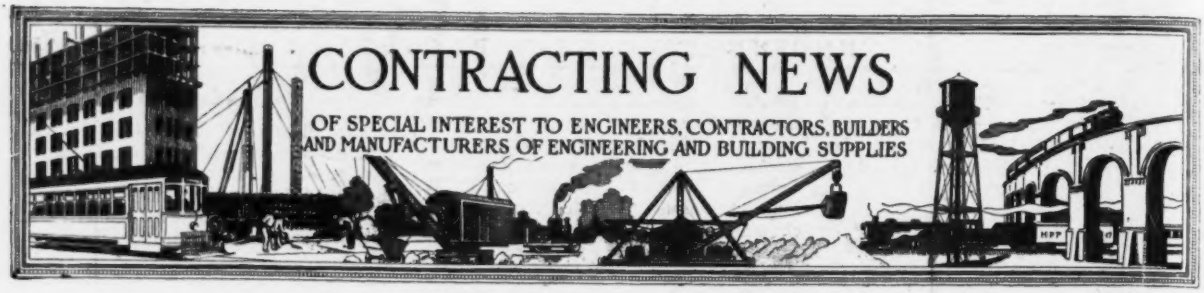
The Dingle-Clark Co. has been organized with offices at 536 Engineers' Building, Cleveland, Ohio, and will handle a complete line of motors, transformers, controllers and turbo-gears. The organizers, Howard Dingle and W. W. Clark, were until Feb. 1 respectively district manager and assistant manager of the Crocker-Wheeler Co. in Cleveland. Both are well known in Ohio electrical circles by reason of their ten years' activity in this territory.

The New York office of the Fort Pitt Bridge Works has been removed to 29 Broadway. Schuyler B. Knox, contracting engineer, is in charge.

Kern-Hunter Co., distributor of contractors' equipment, Milwaukee, Wis., announces that it has taken on the complete line of contractors' and industrial plant equipment made by the Chain Belt Co. The company will represent the Chain Belt Co. in Wisconsin and northern Michigan. Mr. Hunter recently acquired for his company a complete fabricating plant for the manufacture of steel derricks.

S. J. Cogan, one of the best-known contractors' equipment salesmen in Chicago, has joined the sales organization of the Ransome-Leach Company.

New equipment needed by the Bureau of Yards and Docks, Navy Department, has just been announced. At the Philadelphia Navy Yard the bureau plans to install three electric traveling cranes in the aircraft factory, at a cost of about $36,000. Two turbo-generators are also needed at this yard, to cost $36,000. At Puget Sound (Bremerton) two turbo-generators are also needed at about the same cost.


CONTRACTING NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Proposals

For Proposals Advertised See Pages 43, 43a and b and 44 Inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 22	Harrisburg, Pa.	Mar. 21
Mar. 23.	Billings, Mont.	Mar. 7
Mar. 25	Oregon, Ont.	Mar. 21
Mar. 26	Norwood, O. (Cincinnati, P. O.)	Mar. 21
Mar. 26	Cincinnati, O.	Mar. 21
Mar. 26	Niagara, Wis.	Mar. 21
Mar. 28	Ontario, Ore.	Mar. 21
Mar. 29	Fremont, Neb.	Mar. 21
Mar. 30	York Twp., Ont.	Mar. 21
Mar. 31	Pratt, Kan.	Mar. 21

SEWERS

Mar. 22	Long Island City, N. Y.	Mar. 21
Mar. 23	West Allis, Wis.	Mar. 21
Mar. 25.	Stratford, Conn.	Feb. 28
Mar. 25	Cincinnati, O.	Mar. 21
Mar. 25	Plainfield, N. J.	Mar. 21
Mar. 26.	Long Beach, Calif.	Mar. 14
Mar. 26.	Columbus, O.	Mar. 14
Mar. 26	Columbus, O.	Mar. 21
Mar. 26	Cincinnati, O.	Mar. 21
Mar. 26	Kenosha, Wis.	Mar. 21
Mar. 28	Cleveland, O.	Mar. 21
Apr. 1	Salina, Kan.	Mar. 21
Apr. 2.	Toledo, O.	Mar. 14

BRIDGES

Mar. 25.	Lancaster, O.	Mar. 7
Mar. 25	Wheaton, Ill.	Mar. 21
Mar. 26	Belleville, Ill.	Mar. 21
Mar. 28	Ft. Wayne, Ind.	Mar. 21
Mar. 28	Wampum, Pa.	Mar. 28
Mar. 30.	Caledonia, Minn.	Mar. 7
Apr. 1	Franklin, W. Va.	Mar. 21
Apr. 1	Salina, Kan.	Mar. 21
Apr. 1	Connersville, Ind.	Mar. 21
Apr. 2	Kansas City, Cal.	Mar. 21
Apr. 2	Watertown, S. D.	Mar. 21
Apr. 2	Greenfield, Ind.	Mar. 21
Apr. 2	Brookings, S. D.	Mar. 21
Apr. 2.	Gregory, S. D.	Feb. 21
Apr. 4.	Williamson, W. Va.	Mar. 14
Apr. 4	Monroe, La.	Mar. 21
Apr. 5	Ft. Wayne, Ind.	Mar. 21
Apr. 6.	Shreveport, La.	Mar. 14
Apr. 9.	Columbus, O.	Mar. 14
Apr. 9	Northbend, Wash.	Mar. 21
Apr. 10	New Martinsville, W. Va.	Mar. 21
Apr. 13	St. Albans, Wis.	Mar. 21
Apr. 13	Mifflintown, Pa.	Mar. 21
Apr. 16	Sisseton, S. D.	Mar. 21
May 1.	Vallejo, Cal.	Feb. 7

STREETS AND ROADS

Mar. 23.	Hazard, Ky.	Feb. 28
Mar. 23.	Atlanta, Ga.	Feb. 28
Mar. 25.	Tracy, Minn.	Mar. 7
Mar. 25.	Lancaster, O.	Mar. 14
Mar. 25	Salem, N. J.	Mar. 21
Mar. 25	Cincinnati, O.	Mar. 21
Mar. 25	Austin, Tex.	Mar. 21
Mar. 25	Ravenna, O.	Mar. 21
Mar. 26.	Pennsylvania	Mar. 14
Mar. 26.	Belleville, Ill.	Mar. 14
Mar. 26	New York, N. Y.	Mar. 21
Mar. 26	Gaffney, Tex.	Mar. 21
Mar. 26	Trenton, N. J.	Mar. 21
Mar. 27	Des Moines, Ia.	Mar. 21
Mar. 27	El Segundo, Cal.	Mar. 21
Mar. 27.	Center City, Minn.	Mar. 7
Mar. 27.	Janesville, Wis.	Mar. 14
Mar. 27	Rhode Island	Mar. 21
Mar. 28	Ft. Wayne, Ind.	Mar. 21
Mar. 28	Michigan	Mar. 21
Mar. 28	Tacoma, Wash.	Mar. 21
Mar. 28	South Boston, Mass (Boston P. O.)	Mar. 21
Mar. 28	St. Joseph, Mich.	Mar. 21
Mar. 29	Ann Arbor, Mich. Adv. Mar. 21.	Mar. 21
Mar. 29.	Ohio	Mar. 14
Mar. 29.	Tazewell, Tenn.	Mar. 14
Mar. 30	Davenport, Ia.	Mar. 21
Apr. 1.	Morgantown, W. Va.	Mar. 7
Apr. 1.	Indiana	Mar. 14
Apr. 1.	Vermillion, S. D.	Mar. 14
Apr. 1	California	Mar. 21
Apr. 1	Drumright, Okla.	Mar. 21
Apr. 1	Sonora, Cal.	Mar. 21
Apr. 1	Franklin, W. Va.	Mar. 21
Apr. 2	Salinas, Cal.	Mar. 21
Apr. 2	Eveleth, Minn.	Mar. 21
Apr. 2	Elkins, W. Va.	Mar. 21
Apr. 2	East San Diego, Cal.	Mar. 21
Apr. 2	Visalia, Cal.	Mar. 21
Apr. 2	Shelton, Wash.	Mar. 21
Apr. 2	Davenport, Ia.	Mar. 21
Apr. 2	Indiana	Mar. 21
Apr. 2.	Hickman, Ky.	Mar. 14
Apr. 2.	Indiana	Mar. 14
Apr. 2.	Richmond, Ky.	Mar. 14
Apr. 3.	Weston, W. Va.	Mar. 14
Apr. 3	Concord, N. C.	Mar. 21
Apr. 4.	Michigan	Mar. 14
Apr. 4.	Defiance, O.	Mar. 14
Apr. 8	Bradentown, Fla.	Mar. 21
Apr. 8	Seattle, Wash.	Mar. 21
Apr. 9	Seattle, Wash.	Mar. 21
Apr. 10	Peru, Ind.	Mar. 21
Apr. 12	Centerville, Tenn.	Mar. 21
Apr. 13	St. Albans, W. Va.	Mar. 21
Apr. 15	Delaware	Mar. 21
Apr. 16	Michigan Adv. Mar. 21.	Mar. 21
Apr. 23.	Santa Domingo, West Indies	Jan. 24
May 1.	Vancouver, Wash.	Feb. 14

EXCAVATION AND DREDGING

Mar. 25	Clarion, Ia.	Mar. 21
Mar. 25	Jefferson, Ia.	Mar. 21
Mar. 25	Northwood, Ia.	Mar. 21
Mar. 25	St. John, Minn.	Mar. 21
Mar. 26.	Winamac, Ind.	Mar. 7
Apr. 1	Maringo, Ia.	Mar. 21
Apr. 5.	Ft. Dodge, Ia.	Mar. 7
Apr. 9.	Oswego, N. Y. Adv. Mar. 14.	Mar. 14
Apr. 9.	Fulton, N. Y. Adv. Mar. 14.	Mar. 14
Apr. 9.	Herkimer, N. Y. Adv. Mar. 14.	Mar. 14
Apr. 10.	Huntington, Ind.	Mar. 7
Apr. 15	Madison, Wis. Adv. Mar. 21.	Mar. 21

INDUSTRIAL WORKS

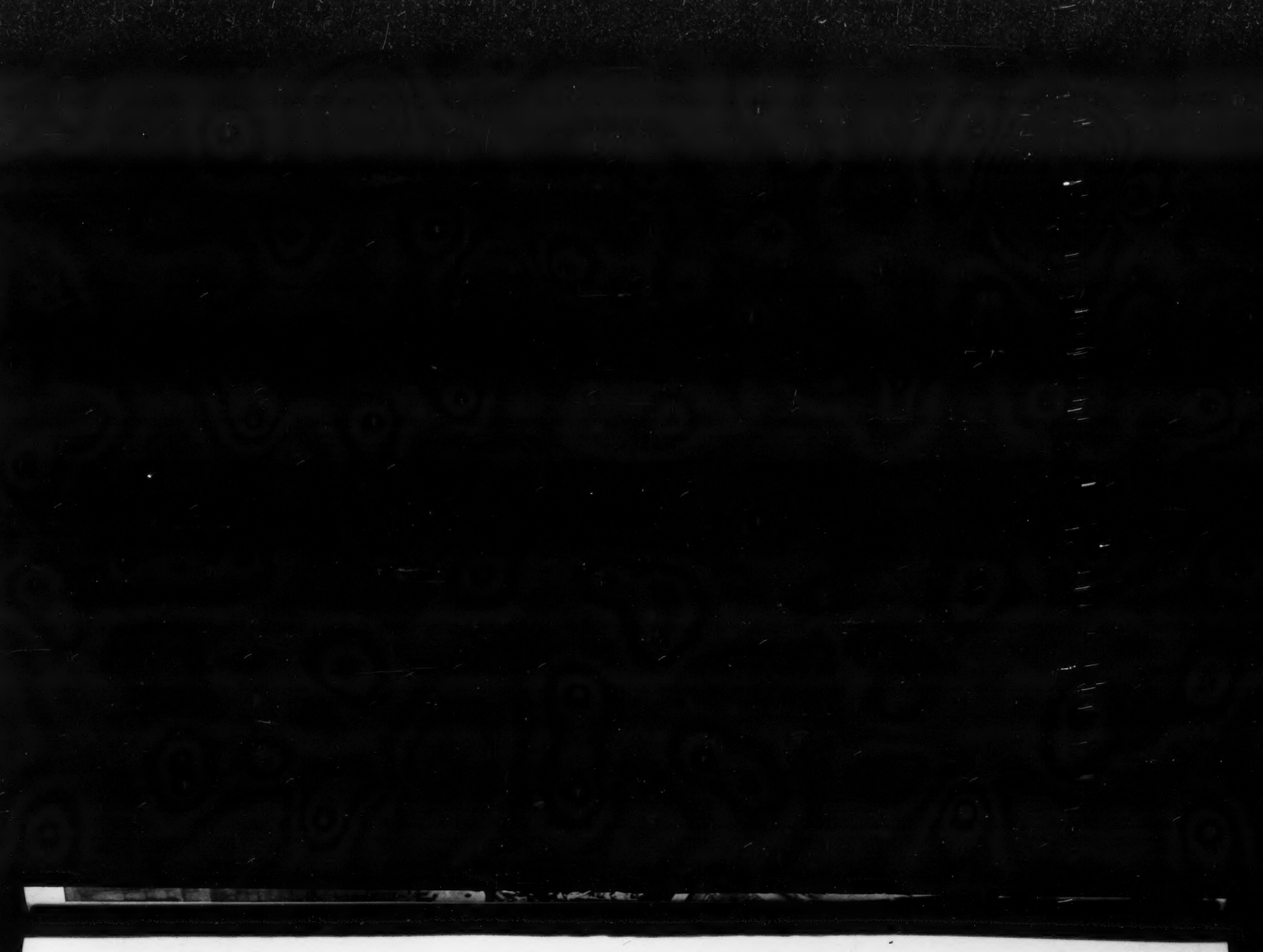
Mar. 25	Yonkers, N. Y.	Mar. 21
Mar. 27	Long Island City, N. Y.	Mar. 21
Apr. 1.	Jersey City, N. J.	Feb. 21
Apr. 1.	Cleveland, O.	Mar. 14
Apr. 2	Portland, Ore.	Mar. 21

BUILDINGS

Mar. 25.	Rockport, Ind.	Feb. 28
Mar. 25.	Fargo, N. D.	Feb. 28
Mar. 25	Missoula, Mont.	Mar. 21
Mar. 25	Rochester, N. Y.	Mar. 21
Mar. 25	New Haven, Conn.	Mar. 21
Mar. 26	Hartford, Conn.	Mar. 21
Mar. 27	Pittsburg, Kan.	Mar. 21
Mar. 27	Erie, Pa.	Mar. 21
Apr. 1	Massapequa, N. Y.	Mar. 21
Apr. 1.	Albany, N. Y.	Feb. 28
Apr. 1.	Cleveland, O.	Mar. 14
Apr. 8	Cincinnati, O.	Mar. 21
Apr. 10	Keyser, W. Va.	Mar. 21
Apr. 10	Marietta, O.	Mar. 21
Apr. 15	Albany, N. Y.	Mar. 21
Apr. 17.	Jersey City, N. J.	Mar. 14

FEDERAL GOVERNMENT WORK

Mar. 23.	Generator Sets, Copper Cable, etc.—Washington, D. C.	Mar. 7
Mar. 25	Distilling Plant — Port Isabell, Tex.	Mar. 21
Mar. 25	Water Supply Connection—Puget Sound, Wash. (Bremerton P. O.)	Mar. 21
Mar. 25.	Marine Railway Depots—San Diego, Cal.	Feb. 28
Mar. 25.	Centrifugal Pumps—Portsmouth, N. H.	Mar. 14
Mar. 25.	Electric Traveling Crane—New Orleans, La.	Mar. 14
Mar. 25.	Beartrap Leaves — Louisville, Ky. Adv. Feb. 28 to Mar. 21.	Feb. 28
Mar. 26	Bridges—Leupp, Ariz.	Mar. 21
Mar. 27.	Steel, Dipper Lips, etc.—Washington, D. C.	Mar. 14
Mar. 28.	Dredging — Philadelphia, Pa.	Mar. 7
Mar. 28.	Repairs to Asphalt Pavement, Washington, D. C.	Mar. 14
Apr. 1.	Dredging—Baltimore, Md. Adv. Mar. 7 to 21.	Mar. 7
Apr. 1	Steel Tank—Norfolk, Va.	Mar. 21
Apr. 1	Fire Protection System — Hingham, Mass.	Mar. 21
Apr. 1	Mechanical Stokers—Philadelphia, Penn.	Mar. 21
Apr. 3.	Levee Works—St. Louis, Mo. Adv. Mar. 14 and 21.	Mar. 14
Apr. 5.	Pipe and Fittings—Ft. Sill, Okla.	Mar. 7
Apr. 5.	Heating Plant — Phoenix, Ariz.	Mar. 14
Apr. 6.	Machinery—Pittsburgh, Pa. Adv. Mar. 14 and 21.	Mar. 14
Apr. 8.	Ditch—El Paso, Tex.	Mar. 14
Apr. 8.	Drainage—Las Cruces, N. M. Adv. Mar. 7.	Mar. 7
Apr. 10.	Revetment, etc. — Nome, Alaska	Feb. 7
Apr. 10	Excavation—Boston, Mass. Adv. Mar. 21.	Mar. 21
Apr. 11	Dredging — New London, Conn. Adv. Mar. 21.	Mar. 21

MISCELLANEOUS

Mar. 23.	Bulkhead—Baltimore, Md. Adv. Mar. 7.	Mar. 7
Mar. 26	Transformers and Regulators—Los Angeles, Cal.	Mar. 21
Mar. 29	Incinerator—Paducah, Ky.	Mar. 21
Apr. 2	Levee Work—Pittsfield, Ill.	Mar. 21
Apr. 2	Steel Reinforcement — Coshocton, O. Adv. Mar. 21.	Mar. 21
Apr. 2	Quay—Beaumont, Tex. Adv. Mar. 21.	Mar. 21
Apr. 6	Civic Center — Baltimore, Md.	Mar. 21
Apr. 15	Levee Work — Muscatine, Ia. Adv. Mar. 21.	Mar. 21